

283077

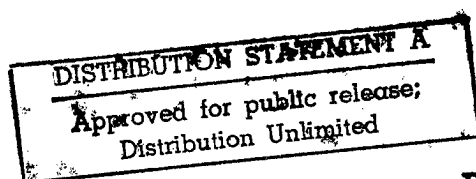
JPRS-UPM-85-005

20 August 1985

# USSR Report

PHYSICS AND MATHEMATICS

19990305 082



DTIC QUALITY INSPECTED 3



FOREIGN BROADCAST INFORMATION SERVICE

4  
163  
A08

JPRS-UPM-85-005

20 August 1985

USSR REPORT

PHYSICS AND MATHEMATICS

**FBIS** FOREIGN BROADCAST INFORMATION SERVICE

REPRODUCED BY  
**NATIONAL TECHNICAL  
INFORMATION SERVICE**  
U.S. DEPARTMENT OF COMMERCE  
SPRINGFIELD, VA. 22161

## NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

## PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

20 August 1985

USSR REPORT  
PHYSICS AND MATHEMATICS

## CONTENTS

## ACOUSTICS

Diffraction of Ultrasonic Beam Passing Normally Through Layered Media (V. S. Kononenko; FIZIKA, No 1, Jan 85).....	1
Speed of Sound in Liquid Sodium Near Gamma-Transition Point (D. L. Timrot, M. A. Serednitskaya, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, Nov 84).....	1
Raman Scattering of Sound on Random Oscillations of Bubbles (Ye. A. Zabolotskaya; KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK, No 10, 1984).....	2
Determination of Parameters of Elastic Spherical Shell From Scattered Wave Field (A. V. Sergeyev; AKUSTICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	2
Stability of a Method for Analyzing Radiation Pattern of Acoustic Radiator With Near-Field Pressure Measurement Errors (I. Ye. Tsukernikov; AKUSTICHESKIYE ZHURNAL, No 1, Jan-Feb 85).....	3
Reflection of Sound From Plate Containing Periodic Inhomogeneities (A. D. Lapin; AKUSTICHESKIY ZHURNAL, No 1, Jan-Feb 85)...	3
Spectrum of Signal Received by Moving Receiver in Underwater Acoustic Channel (A. L. Virovlyanskiy, A. I. Saichev, et al.; AKUSTICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	4



## CRYSTALS AND SEMICONDUCTORS

Influence of Ionizing Radiation on Optical and Paramagnetic Properties of Yttrium Aluminum Garnet Single Crystals (B. I. Minkov, E. P. Nikolova, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	5
Electron Structure of Halide Complexes of Uranyl Considering Spin-Orbital Interaction (N. B. Borkovskiy, A. M. Lyudchik; DOKLADY AKADEMII NAUK BSSR, No 2, Feb 85).....	5
Possible Effects in Solids in Superstrong Magnetic Field (V. V. Druzhinin, A. I. Pavlovskiy, et al.; ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI, No 6(148), Nov-Dec 84).....	6
Conversion of Electromagnetic Wave Energy to Electrical Current by Bulk Superlattice Semiconductor (M. M. Kechiyev, A. A. Kostenko, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, Nov 84).....	7
Cause of Occurrence of High-Energy Ions During UV Laser Irradiation of Molecular Crystals (S. Ye. Yegorov, A. N. Shibanov; ZHURNAL TEKHNICHESKOY FIZIKI, No 11, Nov 84).....	7
Optoacoustic Investigation of Nonlinear Absorption of Ultraviolet Laser Radiation in Alkali-Halide Crystals During Generation of Nonequilibrium Carriers (B. G. Gorshkov, L. M. Dorozhkin, et al.; ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI, No 1, Jan 85).....	8
Evidence of Ferroelectric Transition in $\text{KTiOPO}_4$ Crystals (A. P. Leonov, V. I. Voronkova, et al.; PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI, No 2, 26 Jan 85).....	8
Propagation of Nonequilibrium Acoustic Phonons in Solid Solutions of Aluminum-Based Garnet (S. N. Ivanov, Ye. N. Khazanov; ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI, No 1, Jan 85).....	9
Optical Anomalies in Proustite During First-Order Structural Phase Transition (D. F. Baysa, D. D. Kolendritskiy, et al.; PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI, No 3, 10 Feb 85).....	9

## FLUID DYNAMICS

- Hydrodynamics of Liquid-Vapor Disperse Annular Flows in  
Channels Containing Bundles of Heated Rods Under Nonsteady-  
State Conditions  
(A. Ye. Kroshilin, V. Ye. Kroshilin, et al.;  
TEPLOFIZIKA VYSOKIKH TEMPERATUR, No 5, Sep-Oct 84)..... 10

## GAS DYNAMICS

- Influence of Initial Spatially Inhomogeneous Temperature  
Perturbations on Vibrational Relaxation Dynamics  
(I. A. Kirillov, B. V. Potapkin, et al.; ZHURNAL  
PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI, No 6(148),  
Nov-Dec 84)..... 11
- Ionization Equilibrium in Highly Nonideal Plasma With Condensed  
Disperse Phase  
(D. I. Zhukhovitskiy, A. G. Khrapak, et al.; TEPLOFIZIKA  
VYSOKIKH TEMPERATUR, No 5, Sep-Oct 84)..... 11
- Formation of Micropinches in High-Current Linear z-Pinch With  
Pulsed Gas Injection  
(S. G. Alikhanov, V. I. Vasil'ev, et al.; FIZIKA PLAZMY,  
No 5, Sep-Oct 84)..... 12
- Dynamics of Cylindrical z-Pinch  
(L. S. Solov'ev; FIZIKA PLAZMY, No 5, Sep-Oct 84)..... 12
- Toward a Theory of Atomic Gas Breakdown by Laser Radiation Near  
a Metal Surface  
(V. S. Vorob'ev, A. L. Khomkin; FIZIKA PLAZMY, No 5,  
Sep-Oct 84)..... 13
- Influence of Cesium Admixture on Formation of Inverse  
Populations in Recombining Lithium Plasma  
(S. P. Bogacheva, L. V. Voronyuk, et al.; ZHURNAL  
PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI,  
No 6(148), Nov-Dec 84)..... 14
- Initial Plasma Formation During Exposure of Absorbing  
Materials to Laser Radiation With Plane Expansion Geometry  
of the Forming Plasma  
(L. Ya. Min'ko, Yu. A. Chivel', et al.; ZHURNAL  
PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85)..... 14
- Shockwaves From Extended Light Discharges in Air  
(B. M. Manzoni; ZHURNAL TEKHNICHESKOY FIZIKI, No 11,  
Nov 84)..... 15

Laser Evaporation of Metal in Gaseous Atmosphere (V. I. Igoshin, V. I. Kurochkin; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	15
Explosion in Confined Volume of Gas Under Intense Radiation (I. V. Nemchinov, I. A. Trubetskaya, et al.; ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСKIY FIZIKI, No 6(148), Nov-Dec 84).....	16
Influence of Solid State Obstacles on Radiation of Recombination Laser Plasma (V. A. Boyko, B. A. Bryunetkin, et al.; FIZIKA PLAZMY, No 5, Sep-Oct 84).....	16
Transition From Kinetic to Gas Dynamic Plasma Confinement in Probkotron (V. V. Mirnov, M. S. Pekker; ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСKIY FIZIKI, No 6(148), Nov-Dec 84).....	17
Assessment of Influence of Interaction With Atmosphere Gaseous Impurities on Degree of Dispersion in Aerosols (G. V. Matviyenko, V.G. Sirota; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: FIZIKA, No 1, Jan 85).....	18
Microsphere Sorting Method for Laser Fusion (V. S. Drozhzhin, V. P. Chudinov; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	18
Hydrodynamic and Separation Characteristics of Plasma Centrifuge (Ye. P. Potanin, A. L. Ustinov; FIZIKA PLAZMY, No 5, Sep-Oct 84).....	18
Excitation of Nitrogen Jet by Contracted Discharge Scanned in Magnetic Field (A. A. Ilyukhin, N. I. Lipatov, et al.; PIS'MA V ZHURNAL TEKHNIЧЕСKOY FIZIKI, No 1, 12 Jan 85).....	19
Shortwave Oscillations of Magnetized Plasma Filament With Inhomogeneous Current (F. M. Nekrasov; FIZIKA PLAZMY, No 2, Feb 85).....	19
Ion Temperature in Flux of High-Power Electrodynamic Accelerators (N. I. Arkhipov, A. M. Zhitlukhin, et al.; FIZIKA PLAZMY, No 2, Feb 85).....	20
Alfven Instabilities of Plane Plasma Layer With Homogeneous Ion Beam (V. M. Patudin, A. M. Sagalakov; FIZIKA PLAZMY, No 2, Feb 85).....	20

Laser Initiation of Discharge of Low-Induction Vacuum Spark (G. V. Koloshnikov, K. N. Koshelev, et al.; FIZIKA PLAZMY, No 2, Feb 85).....	21
Two-Dimensional Calculation of Continuous Optical Discharge (G. G. Gladush, A. F. Mamzer, et al.; FIZIKA PLAZMY, No 2, Feb 85).....	21
Surface Combustion of Liquid Fuel in Stream of Gaseous Oxidizer (N. I. Zverev, V. N. Smirnov; FIZIKA GORENIYA V VZRYVA, No 6, Nov-Dec 84).....	22
Explosion Waves Generated by Deflagration Combustion (V. A. Gorev, S. A. Bystrov; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	22
Numerical Modeling of Acceleration of Solid Particles by Gas Jets (V. Z. Kasimov, Yu. P. Khomenko; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	23
Cyclotron Absorption of Electromagnetic Waves Considering Coulomb Collisions (S. B. Isakov, V. N. Tsytovich; FIZIKA PLAZMY, No 2, Feb 85).....	23
Influence of Stochastic Inhomogeneity on Lower Hybrid Plasma Heating (B. D. Obirov, A. M. Rubenchik; FIZIKA PLAZMY, No 2, Feb 85).....	24
Kinetic Effects in Decaying Plasma (B. Ye. Nemtsov; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA, No 1, Jan 85).....	24
Influence of Beam Space Charge on Operation of Plasma Generator (Amplifier) (N. I. Karbushev; KRATKIYE SOOBSHCHENIYE PO FIZIKA: SBORNIK, No 10, 1984).....	25
Jump in Population of Ion Levels at Shockwave Front in Recombining Plasma (V. I. Derzhiyev, S. A. Mayorov, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	25
Plasma Stabilization in Long Equilibrium Configuration Trap (B. A. Trubnikov, V. M. Glagolev, et al.; FIZIKA PLAZMY, No 2, Feb 85).....	26

Gas Dynamic Modes of Aerosol Microflame in Optical Field (V. A. Vdovin, Yu. M. Sorokin; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	26
Excitation of Discharge in Air by Laser Radiation (V. I. Bukatyy, A. A. Kobolov, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	27
Ring Formations in Corona of Filament Exploded by Current (I. K. Ayvazov, L. Ye. Aranchuk, et al.; PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI, No 3, 10 Feb 85).....	27
Two-Dimensional Self-Similar Plasma Flows With Azimuthal Magnetic Field (A. L. Velikovich, M. A. Liberman, et al.; PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI, No 3, 10 Feb 85).....	28
Aerodynamics and Heat Exchange Between Front of Forest Fire and Ground Layer of Atmosphere (A. M. Grishin, A. D. Gruzin, et al.; ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI, No 6(148), Nov-Dec 84).....	28
Toward the Theory of Rapid Magnetic Field Evolution in Two- Component Electron Plasma (M. B. Isichenko, K. V. Chukbar, et al.; PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI, No 3, 10 Feb 85).....	29
Heat Convection in Flame of Plasmotron With Hot Electrodes (N. V. Pashatskiy, I. G. Kravchenko, INZHENERNO- FIZICHESKIY ZHURNAL, No 2, Feb 85).....	29
Influence of Reabsorption of Radiation on Thermal Characteristics of Electric Arcs in Stream of Air (L. N. Panasenko, V. G. Sevast'yanenko; INZHENERNO- FIZICHESKIY ZHURNAL, No 2, Feb 85).....	30
Electrical Arc in Vortex Gas Flow (V. V. Berbasov, M. F. Zhukov; INZHENERNO- FIZICHESKIY ZHURNAL, No 2, Feb 85).....	30
Influence of Physical-Chemical Properties of Gases on Interaction Between Shockwaves and Convex Cylindrical Surfaces (L. G. Gvozdeva, Yu. P. Lagutov, et al.; INZHENERNO- FIZICHESKIY ZHURNAL, No 2, Feb 85).....	31

# HIGH-TEMPERATURE PHYSICS

Throwing of Plane Porous Layers by Sliding Detonation Wave (Yu. A. Pavlov, A. M. Staver, et al.; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	32
Mechanism Underlying Ablation of Metals Caused by Explosion Plasma (Ye. G. Popov; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	32
Calculation of Formation Time of Minimal Nucleus of Flame During Ignition of Explosive Mixtures by Electrical Discharges (N. I. Lobyzov, N. M. Karmazinov; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	33
Flame Propagation in Pulsed Acceleration Field (V. P. Samsonov; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	33
State Equations of Explosion Products of Condensed Explosives (V. P. Zubarev, A. A. Yevstigneyev; FIZIKA GORENIYA I VZRYVA, No 6, Nov-Dec 84).....	34
Investigation of Structure and Propagation Limits of Front of Treetop Forest Fire (A. M. Grishin, A. D. Gruzin, et al.; FIZIKA GORENIYA I VZRYVA, No 1, Jan-Feb 85).....	34
Kinetics of Subthreshold Glow and Microwave Conductivity in Glass Subjected to Laser Heating (N. Ye. Kask, G. M. Fedorov, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	35
Experimental Investigation of Structure of Front of Treetop Forest Fire (A. M. Grishin, V. V. Plyukhin; FIZIKA GORENIYA I VZRYVA, No 1, Jan-Feb 85).....	35
Focus Mechanism Underlying Combustion of Certain Secondary Explosives by Monochromatic Light Pulse (L. G. Strakovskiy; FIZIKA GORENIYA I VZRYVA, No 1, Jan-Feb 85).....	36
Occurrence of Pressure Wave During Spontaneous Ignition of Gas Ahead of Flame Front in Closed Vessel (V. I. Vodyanik, S. V. Tarakanov; FIZIKA GORENIYA I VZRYVA, No 1, Jan-Feb 85).....	36

Steady-State Detonation of Charges of Finite Length (V. K. Ashayev, G. S. Doronin, et al.; FIZIKA GORENIYA I VZRYVA, No 1, Jan-Feb 85).....	37
LASERS	
Hyperboloids of the 21st Century (G. A. Abil'sitov, Interview; LENINSKOYE ZNAMYA, 2 Oct 84).....	38
The Microworld - Caught in Laser Beams (R. Chesna; SOVETSKAYA LITVA, 21 Oct 84).....	42
Lasing on Vapors of Chain Compounds (V.V. Gruzinskiy, K.M. Degtyarenko, et al.; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA, No 1, Jan 85).....	44
Energy Characteristics of Laser With Saturable Anisotropic Absorbing Medium in Cavity (A. P. Voytovich, V. V. Mashko; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	44
Efficiency of $\text{LiF:F}^{2-}$ Crystal Lasers as Function of Pumping Pulse Length (S. A. Mikhnov, V. V. Rakush; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	45
Investigation of Efficiency of Generation of Difference- Frequency Laser Radiation in Waveguide (A. O. Makaryan, K. M. Movsisyan, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	45
Influence of Excited Singlet States of Molecules on Four-Wave Interaction Efficiency in Dye Solutions (V. V. Kabanov, A. S. Rubanov, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	46
Spectrum Structure of XeCl Electric Discharge Laser (V. S. Burakov, A. F. Bokhonov, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	46
Interference of Ninth-Order Resonant Processes and Seventh- Order Nonresonant Processes in Generation of Seventh Harmonic of Neodymium Laser in Mercury Vapors (S. A. Myslivets, V. F. Lukinykh, et al.; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	47
Distributed-Feedback Lasers With Active Framing Medium (Yu. N. Ryzhov, I. V. Cheremiskin, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	47

Investigation of Polarization Characteristics of Radiation From Laser With Dye-Activated Polymer Elements (V. S. Burakov, N. N. Vasil'ev, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	48
High-Efficiency $Al_2O_3:Ti^{3+}$ Tunable Laser (G. S. Kruglik, G. A. Skripko, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	48
Ultraviolet Lasing in Helium-Nitrogen Mixtures (E. I. Asinovskiy, L. M. Vasilyak, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	49
Electroionization IR Xe-Atom Laser (N. G. Basov, V. A. Danilychev, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	49
Size-Quantization Level Laser With Separate Electron and Optical Limitations (Al. G. Aleksanyan, A. G. Aleksanyan, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	50
Optimization of Parameters of Chemical CO Laser by Increasing Length of Active Medium (V. A. Dudkin, V. B. Rukhin; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	51
Powerful Pulsed $CO_2$ Laser With Plasma Electrodes (V. P. Gorkovskiy, N. V. Karlov, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	51
Frequency Modulation of Radiation of Two-Component Injection Laser With Coupled Cleaved Cavity (I. S. Goldobin, V. N. Luk'yanov, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	52
Formation of Charge and Energy Spectrum of Multiply-Charged Ions of Expanding Laser Plasma (A. A. Golubev, S. V. Latyshev, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	52
Powerful $LiIO_3$ Parametric Optical Oscillator for IR Laser Chemistry (I. I. Ashmarin, Yu. A. Bykovskiy, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	53
Regular and Stochastic Self-Modulation of Radiation in Ring Laser With Nonlinear Element (A. Yu. Okulov, A. N. Orayevskiy; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	53



Frequency Resonances in Two-Mode He-Ne/I <sub>2</sub> Laser (S. A. Gonchukov, S. V. Kireyev; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	54
Thermooptical Distortions and Large-Scale Self-Focusing in Active Elements of Powerful Laser Systems (A. N. Tikhonov, V. Ya. Arsenin, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	54
Influence of Pumping Mode on Lasing in He-Xe Optical Breakdown Plasma (V. V. Apollonov, F. V. Bunkin, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	55
Efficiency of Optically-Pumped XeF-Laser (V. S. Zuyev, L. D. Mikheyev, et al.; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	55
Investigation of Variation in Angular Divergence of Radiation From Helium-Neon Laser ( $\lambda = 3.39 \mu\text{m}$ ) as Function of Dispersion Characteristic of Active Medium (A. V. Astakhov, Yu. V. Gorlov, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	56
Helium-Europium Laser With Specific Radiation Energy of 5J/1·atm (P. A. Bokhan, L. Ye. Yegorov; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	56
Radiation Spectrum of YAG:Nd <sup>3+</sup> Laser With Nonstationary Cavity (O. N. Kapralova, L. N. Kaptsov; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	57
Cathode-Luminescent Pumped R6G Laser (V. M. Lisitsyn, G. O. Lyakh, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	57
Reduction of Threshold Current of InGaAsP/InP Heterolasers Subjected to Unilateral Compression (P. G. Yeliseyev, B. N. Sverdlov; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	58
Intense Compression of Dye-Laser Pulses Employing Picosecond Single-Pulse Excitation (V. M. Petnikova, S. A. Pleshanov, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	58
Investigation of Tunable CO <sub>2</sub> Laser Excited by Transverse High-Frequency Discharge (V. N. Ryabykh, V. A. Svich, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	59

Energy Characteristics of Waveguide CO <sub>2</sub> -Laser (Yu. B. Konev, N. I. Lipatov, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	59
Energy Transport by $\alpha$ -Particles in Laser Plasma Contained in Magnetic Field (S. Yu. Gus'kov, V. B. Rozanov, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	60
Chromium- and Neodymium-Activated Gadolinium-Scandium-Gallium Garnet Crystal: a New Laser Active Medium (Ye. V. Zharikov, V. V. Laptev, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	61
Two-Frequency Passive Mode Locking in Iodine Photodissociation Laser (V. M. Kiselev, A. S. Grenishin, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	61
Long-Wave Molecular Lasers and Prospects for Development (a Review) (N. Ye. Molevich, A. N. Orayevskiy; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	62
Efficient Generation of Second Harmonic of Tunable CO <sub>2</sub> Laser in ZnGeP <sub>2</sub> (Yu. M. Andreyev, V. G. Voyevodin, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	62
Injection Heterolasers With Enhanced Radiation Characteristics (A. S. Adlivankin, S. A. Alaverdyan, et al.; ZHURNAL TEKHNIЧЕСКОY FIZIKI, No 11, Nov 84).....	63
Stability of Transverse Particle Motion in Accelerator Employing Magnetic Quadrupole Focusing (N. A. Khizhnyak, V. M. Khoruzhiy, et al.; ZHURNAL TEKHNIЧЕСКОY FIZIKI, No 11, Nov 84).....	63
Transverse Instability of High-Current Beam in Multisection Proton Accelerator (L. V. Kravchuk, P. N. Ostroumov, et al.; ZHURNAL TEKHNIЧЕСКОY FIZIKI, No 11, Nov 84).....	64
Generation of Powerful Microwave Radiation by High-Current Electron Mini-Accelerators (A. S. Yel'chaninov, S. D. Korovin, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, Nov 84).....	64
Lightguide Cavity Ring Garnet Laser (Ye. M. Dianov, A. M. Zabelin, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	65

Electron Distribution Function in Optical Laser Radiation Field in Molecular Gas (V. P. Konovalov, E. Ye. Son; FIZIKA PLAZMY, No 5, Sep-Oct 84).....	65
Low-Threshold Optical Breakdown in Polarized Radiation (A. M. Bonch-Bruyebich, V. N. Smirnov; ZHURNAL TEKHNICHESKOY FIZIKI, No 11, Nov 84).....	66
Influence of Induced Absorption in Reflection Material on Efficiency of Solid State Lasers (S. P. Nasel'skiy, V. K. Novikov, et al.; KVANTOVAYA ELEKTRONIKA, No 8, Aug 84).....	66
Coherent Anti-Stokes Light Scattering Diagnosis of Capillary Discharge of CO <sub>2</sub> Waveguide Laser (A. A. Vakhterov, A. A. Ilyukhin, et al.; PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI, No 1, 12 Jan 85).....	67
Effect of Spontaneous Emission at the Working Transition on Noise in a Ring Laser (G. N. Zmiyevskoy; OPTIKA I SPEKTROSKOPIYA, No 2, Feb 85).....	67
Effect of Perturbations of the Discharge Current on the Beat Frequency of Circularly Polarized Counter-Propagating Waves in a Zeeman Ring Laser With Reversible Frequency Base (V. I. Chetverikov; OPTIKA I SPEKTROSKOPIYA, No 2, Feb 85).....	68
Stimulated Raman Scattering Within Cavity of Monopulse Ruby Laser (V. A. Orlovich; VESTSI AKADEMII NAVUK BSSR SERYYA FIZIKA-MATEMATYCHNYKH NAVUK, No 1, Jan-Feb 85).....	68
Waveguide CO-Laser for Monitoring Atmospheric Pollution (S. T. Kornilov, Ye. D. Protsenko, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	69
Calculation of Emitted Pulse Length of Solid-State Q- Modulated Laser (V. P. Minayev, V. M. Plotnikov, et al.; RADIOTEKHNIKA I ELEKTRONIKA, No 2, Feb 85).....	69
A Method for Stabilizing Emitted Power of HF-Pumped CO <sub>2</sub> Laser (A. T. Mirzayev, V. A. Stepanov, et al.; RADIOTEKHNIKA I ELEKTRONIKA, No 2, Feb 85).....	70

Pulsed Separately-Limited InGaAsP/GaAs Dual Heterostructure Liquid-Epitaxy Laser Producing 77 mW ( $T = 300$ K, $\lambda = 0.87 \mu\text{m}$ ) (D. Z. Garbuzov, I. N. Arsent'ev, et al.; FIZIKA I TEKHNIKA POLUPROVODNIKOV, No 1, Jan 85).....	70
Electroionization Excitation of $\text{H}_2(\text{D}_2):\text{He}(\text{Ar})$ Mixtures (N. G. Basov, V. D. Zvorykin, et al.; KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK, No 10, 1984).....	71
Color-Center Passive-Shutter Laser for Dye Pumping (I. M. Korda, A. N. Rubinov; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 2, Feb 85).....	71
Neodymium-Glass Laser Producing Variable-Length U-Shaped Pulse (V. K. Goncharov, D. V. Zhuk; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 2, Feb 85).....	72
Optimization of Optical Density of Active Elements Subjected to Longitudinal Laser Excitation (S. A. Mikhnov, V. V. Rakush; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 2, Feb 85).....	72
Effective Frequency Conversion Under Non-Resonant Conditions at Hydrogen Wavelength $\text{L}_{\alpha}$ (S. A. Batishche, V. S. Burakov, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	73
Pulse Electroionization Lasers With Cryogenically Cooled Active Medium (N. G. Basov, V. G. Bakayev, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	73
Possibility of Expanding Range of Generated Excimer Molecule Wavelengths (I. S. Gorban', N. G. Zubrilin, et al.; DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA A FIZIKOMATEMATICHESKIYE I TEKHNICHESKIYE NAUKI, No 12, Dec 84).....	74
Solution of Lorenz System of Equations in the Asymptotic Limit of Large Rayleigh Numbers. I. Lorenz System in the Simplest Quantum Model of a Laser and Application of the Method of Averaging (L. A. Pokrovskiy; TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA, No 2, Feb 85).....	74
Oscillations of Argon Laser Plasma (V. A. Karasev, V. M. Salimov; DOKLADY AKADEMII NAUK TADZHIKSKOY SSR, No 10, Oct 84).....	75

## NUCLEAR PHYSICS

Achievements of the High Energy Physics Institute (S. Kulinich; LENINGRADSKOYE ZNAMYA, No 6(19784), 17 Mar 85).....	76
The Riddle of the "Ultrasoft" Rays (L. Kim; SOVETSKAYA ROSSIYA, 16 Nov 84).....	79
Windows of Transparency During Dual-Beam Pierce Instability (A. N. Mosiyuk; ZHURNAL TEKHNIЧЕСКОY FIZIKI, No 11, Nov 84).....	80
Modelling of Braking of Uncompensated Electron Beam in Thin Absorbers (V. I. Boyko, Ye. A. Gorbachev, et al.; ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСKIY FIZIKI, No 6(148), Nov-Dec 84).....	80
Thermodynamic Potential of Quark-Antiquark Plasma in Constant Chromomagnetic Field (Sh. S. Agayev, A. S. Vshivtsev, et al.; IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: FIZIKA, No 1, Jan 85).....	81
Calculation of Energy Characteristics of Accelerators With Azimuthal Electron Drift (S. D. Grishin, M. K. Marakhtanov, et al.; FIZIKA PLAZMY, No 2, Feb 85).....	81
Half-Life of Curium-245 With Respect to Spontaneous Fission (A. A. Druzhinin, V. N. Polynov, et al.; DOKLADY AKADEMII NAUK SSSR, No 6, Feb 85).....	82
Manifestation of Slipping Instability in Partially Compensated Relativistic Electron Beams (N. I. Karbushev, A. A. Rukhadze, et al.; KRATKIYE SOOBSHCHENIYA PO FIZIKI: SBORNIK, No 10, 1984).....	82
Recording Proton Beam Characteristics in Cyclotron During Repeated Passes Through Target (I. Ya. Barit, L. N. Katsaurov, et al.; KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK, No 10, 1984).....	83

## OPTICS AND SPECTROSCOPY

Diffraction Theory of Displacement of Bounded Wave Beams During Reflection. I. (O. A. Godin; ZHURNAL TEKHNIЧЕСКОY FIZIKI, No 11, Nov 84).....	84
--	----

Scattering of Terahertz Phonons on Yttrium-Aluminum Garnet Crystals (A. P. Abramov, I. N. Abramova, et al.; FIZIKA TVERDOGO TELA, No 1, Jan 85).....	85
Vibrational Spectra and Structure of NaF-GeO <sub>2</sub> Glasses (I. A. Mukhitdinova, V. O. Kabanov, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 6, Dec 84).....	85
Algorithm for Reduction to Ideal Device (A. A. Yakovlev; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85)...	86
Experimental Investigation of Recording of Dynamic Holograms Within Absorption Contour of Resonant Atomic Medium (A. Ye. Korolev, D. I. Stasel'ko; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	86
Diffraction Efficiency of Three-Dimensional Phase Hologram of Diffuse Object (Yu. L. Korzinin, V. I. Sukhanov; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	87
Regular Reflection (Transmission) of Radiation by Rough Surfaces: Utilization for Mirror Quality Control (M. Yu. Sakhnovskiy; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	87
Splitting of Completely Reflected Incident Beam Into Two Elliptically Polarized Beams (N. N. Pun'ko, V. V. Fillipov; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	88
Optical Investigations of Spin Waves Excited Parametrically by Perpendicular Pumping (A. A. Solomko, Yu. A. Gayday, et al.; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	88
Phase Effects During Reflection of Light From Boundary of Media With Similar Indices of Refraction (G. B. Al'tshuler, V. S. Yermolayev; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	89
Possibility of Optimal Choice of Exposure Time for Holographic Recording of Objects Through Unsteady Scattering Media (O. V. Angel'skiy, V. V. Yatsenko, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	89
Investigation of Qualitative Characteristics of Image Recovered From Hologram Without Reference Beam (I. I. Mokhun', S. N. Roslyakov; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	90

Investigation of Radiation Absorption Efficiency and Distribution of Heat Sources Within Weakly Absorbing Two- Layer Particles of Aqueous Aerosol Under Optical Resonance Conditions (A. P. Prishival'ko, L. G. Astaf'eva, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	90
Distribution of Radiant Emittance and Luminance on Surface of Light-Scattering Sphere (M. N. Borisevich, A. B. Gavrilovich, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	91
1,3,2-Dioxaborines--a New Class of Laser Dyes (N. N. Vasil'ev, A. Ya. Gorelenko, et al.; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 1, Jan 85).....	91
Algorithm for A Posteriori Reconstruction of Complete Image of Destabilized Object From Series of Atmosphere-Degraded Brief Exposure Images of N Different Aspects (P. A. Bakut, K. N. Sviridov, et al.; OPTIKA I SPEKTROSKOPIYA, No 4, Oct 84).....	92
Offset of Image of Objects in Optical Detection and Ranging With Severe Intensity Fluctuations in Turbulent Atmosphere (V. P. Aksenov, V. A. Banakh, et al.; OPTIKA I SPEKTROSKOPIYA, No 4, Oct 84).....	92
Optimization of Modulation Transfer Functions of Imaging Systems Looking Through Randomly Heterogeneous Media (A. N. Valentyuk, S. I. Metelitsa; OPTIKA I SPEKTROSKOPIYA, No 4, Oct 84).....	93
Investigation of Fluctuations in Polarizability of Macro- scopically Homogeneous Media Scattering Coherent Radiation (I. M. Bel'govskiy, G. N. Korniyenko, et al.; OPTIKA I SPEKTROSKOPIYA, No 4, Oct 84).....	93
General-Purpose Equipment for Airborne Laser Remote Sensing of Ocean, Atmosphere and Agricultural Crops (A. F. Bunkin, D. V. Vlasov, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 11, Nov 84).....	94
Laser Doppler Methods for Measuring Spatial Structure of Turbulence (B. S. Rinkevichyus, V. I. Smirnov, et al.; TEPILOFIZIKA VYSOKIKH TEMPERATUR, No 5, Sep-Oct 84).....	94
Estimation of Deviations of Spectral Characteristics of Optical Coatings (N. V. Grishina, A. V. Tikhonravov; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	95

Ellipsometric Investigation of Optically Polished Surface of Copper (M. N. Churayeva, Z. M. Zorin, et al.; POVERKHNOST'. FIZIKA, KHIMIYA, MEKHANIKA, No 2, Feb 85).....	95
Relationship Between Chemically Heterogeneous Structure of Glass and Optical Breakdown Threshold (G. O. Karapetyan, L. V. Maksimov; KVANTOVAYA ELEKTRONIKA, No 9, Sep 84).....	96
Excitation of Nonlinear Surface Waves by Gaussian Light Beams (N. N. Akhmediyev, V. I. Korniyev, et al.; ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI, No 1, Jan 85).....	96
Distinctive Features of Coherent Amplification of Radiation in Pumping Direction During Resonant Raman Scattering (L. A. Bol'shov, N. N. Yelkin, et al.; ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI, No 1, Jan 85).....	97
Photoinduced Rayleigh Scattering of Light in Crystals (V. V. Obukhovskiy, A. V. Stoyanov; OPTIKA I SPEKTROSKOPIYA, No 2, Feb 85).....	97
Multiphonon Raman Scattering of Light Excited in Crystals by a Copper-Vapor Laser (A. M. Agal'tsov, V. S. Gorelik, et al.; OPTIKA I SPEKTROSKOPIYA, No 2, Feb 85).....	98
Phasing of Multiple-Aperture Optical Systems (P. A. Bakut, A. D. Rayakin, et al.; OPTIKA I SPEKTROSKOPIYA, No 2, Feb 85).....	98
On the Redefinition of the Energy Coefficients of Reflection and Transmission of Light at the Interface Between Absorbing and Transparent Media (I. M. Minkov; OPTIKA I SPEKTROSKOPIYA, No 2, Feb 85)....	99
Absorption of Radiation in Multilayered Spherical Particles (V. A. Babenko, L. G. Astaf'yeva; VESTSI AKADEMII NAVUK BSSR SERIYA FIZIKA-MATEMATYCHNYKH NAVUK, No 1, Jan-Feb 85).....	99
Influence of Spatial Coherence of Light Source on Intensity Distribution of Reflected Radiation in Focal Plane of Telescope (V. A. Banakh, V. M. Buldakov, et al.; OPTIKA I SPEKTROSKOPIYA, No 1, Jan 85).....	100



A Complex Eikonal and Its Application (Yu. A. Anan'ev; DOKLADY AKADEMII NAUK SSSR, No 5, Dec 84).....	100
Nonlinear Scattering of Light on Static Optical Inhomogeneities (G. B. Al'tshuler, V. S. Yermolayev; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 2, Feb 85).....	101
Transformation of Light Pulse Shape by Thin Plane-Parallel Layer of Absorbing Material (N. I. Insarova, G. I. Olefir; ZHURNAL PRIKLADNOY SPEKTROSKOPII, No 2, Feb 85).....	101
Convex X-Ray Band Rotating Mirrors. I. (A. V. Vinogradov, V. F. Kovalev, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	102

#### THEORETICAL PHYSICS

Resonant Generation of Plasma Oscillations by Plane Gravity Wave (Yu. F. Ignat'yev; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA, No 1, Jan 85).....	103
Stochastic Quantization and (First-Order) Renormalization of n-Field Model (I.D. Vaysburd; IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA, No 1, Jan 85).....	103
Creation of Multidimensional Chaos in Active Lattices (A. V. Gaponov-Grekhov, M. I. Rabinovich, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, Nov 84).....	104
Focusing of Charged-Particle Beams by Inhomogeneous Magnetic Field (E. L. Burshteyn, L. A. Roginskiy; ZHURNAL TEKHNICHESKOY FIZIKI, No 11, Nov 84).....	104
Toward a Theory of Low Frequency Magnetosonic Solitons (A. B. Mikhaylovskiy, A. I. Smolyakov; ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI, No 1, Jan 85).....	105
Propagation of Wave Packets in Nonlinear Amplifying (Absorbing) Media (F. G. Bass, N. N. Nasonov, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 2, Feb 85).....	106

## THERMODYNAMICS

- Hydrothermodynamics of the Near-Surface Layer of a Liquid  
and Optical Methods of Investigating It  
(O. D. Fedorovs'kyy, Ye. I. Nykyforovych; VISNYK  
AKADEMIYI NAUK UKRAYINS'KOYI RSR, No 11, Nov 84)..... 107
- Experimental Investigation of Heat Release During Turbulent  
Flow in Round Tube of Non-Equilibrium Dissociating Coolant  
(E. I. Molodykh, V. P. Novikov, et al.; TEPILOFIZIKA  
VYSOKIKH TEMPERATUR, No 5, Sep-Oct 84)..... 116
- Model Calculation of the Temperature Field of an Ideal  
Parabolic Reflector  
(A. Nazarov, Sh. Nazarov, et al.; IZVESTIYA AKADEMII  
NAUK TURKMENSKOY SSR: SERIYA FIZIKOTEKHNIЧЕСКИХ,  
KHIMICHESKIKH I GEOLOGICHESKIKH NAUK, No 6, Nov-Dec 84).. 116
- Heating of Metal Surface by Laser Radiation Considering  
Temperature Dependence of Reflectivity  
(S. N. Kapel'yan, Yu. F. Morgun; VESTSI AKADEMII  
NAVUK BSSR SERIYA FIZIKA-MATEMATYCHNYKH NAVUK,  
No 1, Jan-Feb 85)..... 117

## LOGIC AND GAME THEORY

- H-Convex Set Method in Differential Games  
(V. V. Ostapenko; DOKLADY AKADEMII NAUK UKRAINSKOY SSR:  
SERIYA A FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСКИYE  
NAUKI, No 12, Dec 84)..... 118

## NUMERICAL ANALYSIS AND ALGORITHMS

- Determination of Extremal Eigenvalues by Minimization of  
Functionals of Special Type  
(G. V. Savinov; ZHURNAL VYCHISLITEL'NOY MATEMATIKI I  
MATEMATICHESKOY FIZIKI, No 2, Feb 85)..... 119
- Coincidence of Errors in Classes of Passive and Sequential  
Algorithms  
(A. G. Sykharev; ZHURNAL VYCHISLITEL'NOY MATEMATIKI I  
MATEMATICHESKOY FIZIKI, NO 2, Feb 85)..... 119
- Diffusion Chaos in Nonlinear Dissipative Systems  
(T. S. Akhromeyeva, S. P. Kurdyumov, et al.; DOKLADY  
AKADEMII NAUK SSSR, No 5, Dec 84)..... 120

Error of Monte Carlo Method in Solving Vector Transfer Equation (G. A. Mikhaylov; DOKLADY AKADEMII NAUK SSSR, No 5, Dec 84).....	120
Development of Methods for Certifying Algorithms for Processing Observation Results (Yu. V. Tarbeyev, I. B. Chelpanov, et al.; METROLOGIYA, No 2, Feb 85).....	121
PROBABILITY AND STATISTICS	
Validation of Unilateral $3\sigma$ Rule for Unimodal Distributions (D. F. Vysochanskiy, Yu. I. Petunin; DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI, No 1, Jan 85).....	122
Entropy Maximality Criterion for Boundary of Random Walks on Discrete Groups (V. A. Kaymanovich; DOKLADY AKADEMII NAUK SSSR, No 5, Feb 85).....	122
Limiting Theorems for Functionals of Irreversible Random Walks (T. M. Merzoyeva, N. I. Portenko; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	123
Stability With Probability of Unity for Systems of Linear Stochastic Differential Equations (I. A. Rudomino-Dusyatskaya; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	123
Solvability of Stochastic Differential Equations With Deviating Argument (A. Ye. Rodkina; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	124
Structure of Rigorously Markovian Marked Random Closed Sets (I. S. Molchanov; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	124
Investigation of Methodical Error Component of Statistical Analysis of Extrema (V. I. Zhulev, V. I. Petukhov, et al.; AVTOMETRIYA, No 6, Nov-Dec 84).....	125
Asymptotic Behavior of Solutions of Heat Conductivity Equation With White Noise on Right-Hand Side (A. Ya. Dorogovtsev, S. D. Ivasishen, et al.; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85)....	125

The Elliptical Law (V. L. Girko; DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI, No 1, Jan 85).....	126
---	-----

Limit Theorem for Variable-Step Optimization and Estimation Algorithms (Yu. M. Kaniovskiy; DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI, No 1, Jan 85).....	126
--	-----

## CONTROL THEORY

Optimum Conjugation of Non-Singular Control Sections in a Terminal Control Problem (K. B. Mansimov; SOOBShCHENIYA AKADEMII NAUK GRUZINSKOY SSR, No 1, Oct 84).....	127
---	-----

Optimality Conditions in Optimization Problems With an Integral Quality Condition (S. N. Abramenko, Yu. B. Seysov, et al.; IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR; SERIYA FIZIKO- TEKHNIЧЕСKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK, No 6, Nov-Dec 84).....	127
---	-----

Toward Necessary Conditions for Optimality in Problem With Phase Constraints (A. V. Arutyunov; DOKLADY AKADEMII NAUK SSSR, No 5, Feb 85).....	128
--	-----

Method for Approximate Solution of One Linear Optimal Control Problem Depending Upon Small Parameter (A. I. Kalinin, G. A. Romanyuk; DOKLADY AKADEMII NAUK BSSR, No 2, Feb 85).....	128
--	-----

Bicriterion Problem in Theory of Scheduling With Variable Maintenance Time (A. V. Tuzikov; ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI, No 10, Oct 84).....	129
--	-----

Construction of Functional Relationships of Measured Quantities With Incomplete Initial Data (V. A. Balalayev, V. N. Romanov, et al.; METROLOGIYA, No 2, Feb 85).....	130
--	-----

Necessary Extremum Conditions in Minimax Problem of Optimal Control of Non-Smooth Systems With Constraints (P. V. Gayshun, B. Sh. Mordukhovich; VESTSI AKADEMII NAVUK BSSR SERIYA FIZIKA-MATEMATYCHNYKH NAVUK, No 1, Jan-Feb 85).....	130
---	-----

Existence Theorem for One Class of Optimal Problems With Switching and Variable Delays (N. M. Avalishvili; SOOBShCHENIYA AKADEMII NAUK GRUZINSKOY SSR, No 1, Oct 84).....	131
--	-----

## DIFFERENTIAL EQUATIONS

Toward the Directional Differentiation of a Distance Function (O. F. Borisenko, R. M. Zhevnyak, et al.; VESTSI AKADEMII NAVUK BSSR SERIYA FIZIKA-MATEMATYCHNYKH NAVUK, No 1, Jan-Feb 85).....	132
Inhomogeneous Boundary-Value Problem for Second-Order Differential-Operator Equation (N. V. Kislov; DOKLADY AKADEMII NAUK SSSR, No 5, Feb 85).	132
Straight-Line Method for Quasilinear Parabolic-Type Equation With Nonclassical Boundary Condition (V. L. Makarov, D. T. Kulyyev; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85).....	133
Method of Averaging in Pulsed Systems (Yu. A. Mitropol'skiy, A. M. Samoylenko, et al.; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1, Jan-Feb 85)....	133
The Lyapunov Matrix-Function and the Stability of Motion (A. A. Martynyuk; DOKLADY AKADEMII NAUK SSSR, No 5, Feb 85).....	134
Accuracy of Monotonic Schemes for Solution of Stiff Systems of Differential Equations (P. D. Shirkov; ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI, No 10, Oct 84).....	134
Wave Interaction in Open Resonators (V. N. Koshparenok, P. N. Melezhik, et al.; DOKLADY AKADEMII NAUK SSSR, No 5, Dec 84).....	135
Inversion of Integral Operators With Near Difference Kernel (A. B. Nersesyan, N. A. Chernyavskaya; DOKLADY AKADEMII NAUK ARMYANSKOY SSR, No 1, Jan 84).....	135
Stabilization of Time Averages of Solution of Cauchy Problem for Singular Hyperbolic Equation (V. N. Denisov; DOKLADY AKADEMII NAUK SSSR, No 6, Feb 85).....	136

## GROUP THEORY AND COMBINATORICS

- Solution of Systems of Boolean Equations in Test or Nelson  
Systems  
(A. A. Safaryan; ZHURNAL VYCHISLITEL'NOY MATEMATIKI I  
MATEMATICHESKOY FIZIKI, No 10, Oct 84) ..... 137
- Estimate of Position of Matrix Spectrum With Respect to Plane  
Curves  
(A. G. Mazko; UKRAINSKIY MATEMATICHESKIY ZHURNAL, No 1,  
Jan-Feb 85)..... 138

UDC 531:534.2

DIFFRACTION OF ULTRASONIC BEAM PASSING NORMALLY THROUGH LAYERED MEDIA

Tomsk FIZIKA in Russian Vol 28, No 1, Jan 85  
(manuscript received 9 Feb 84) pp 118-119

KONENENKO, V. S., Kuybyshev Institute of Rail Transport Engineers

[Abstract] The increase in the velocity and absorption of ultrasound passing through media with different acoustic parameters normal to the interface of the media is assessed analytically. Expressions are derived for the boundary conditions for finding the velocity potentials in the media. The diffraction error occurring in measurements of ultrasound absorption in liquids which use delay lines is analyzed as an example. The analysis shows that diffraction errors can be small in spite of substantial diffraction divergence of the ultrasonic beam in delay lines. References 4: 3 Russian, 1 Western.  
[262-6900]

UDC 54.14+546.22+534.22

SPEED OF SOUND IN LIQUID SODIUM NEAR GAMMA-TRANSITION POINT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 3, Nov 84  
(manuscript received 4 Mar 84) pp 617-621

TIMROT, D. L., SEREDNITSKAYA, M. A. and CHKHIKVADZE, T. D., Institute of High Temperatures, USSR Academy of Sciences

[Abstract] This study investigates the speed of sound, which is an accurately measurable characteristic of the behavior of liquid sulfur that changes abruptly at about 432 K, which is called a  $\lambda$ -transition point. The speed of sound is measured at temperatures of 361-493 K, which surrounds the special point and includes a region not investigated previously. The measurements were made by fixed-distance echo pulsation. The precision of the experiment made it possible to establish a singular point in the behavior of the parameter in question as a function of temperature. This point, at

which the temperature coefficient of the speed of sound changes abruptly, is approximately 432 K. Analysis of the temperature dependency of the adiabatic and isothermic compressibility also made it possible to identify a singular point in the behavior of adiabatic compressibility at the  $\lambda$ -transition temperature. Figures 3; references 13: 4 Russian, 9 Western. [162-6900]

UDC 534.222.2

#### RAMAN SCATTERING OF SOUND ON RANDOM OSCILLATIONS OF BUBBLES

Moscow KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK in Russian, No 10, 1984 (signed to press 2 Oct 84) (manuscript received 17 May 84) pp 23-25

ZABOLOTSKAYA, Ye. A., General Physics Institute, USSR Academy of Sciences.

[Abstract] This study investigates the Raman combination frequencies that occur when acoustic waves propagating in a medium containing distributed gas bubbles are scattered on the latter because of nonlinearity of the motion equation of the bubble. The spectral density of the combination-frequency scattered wave is estimated by sequential approximation. It is found that the determining role in Raman scattering of sound on bubbles is played by random forces, random noise and vibrations, the leading edge of the acoustic perturbation and non-steady-state movement when the bubbles are formed, etc. The frequency and spectral density of the oscillations of the volume of bubbles can be found from the Raman scattering spectrum. Reference: 1 Russian. [296-6900]

UDC 539.3:534.1

#### DETERMINATION OF PARAMETERS OF ELASTIC SPHERICAL SHELL FROM SCATTERED WAVE FIELD

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 31, No 1, Jan-Feb 85 (manuscript received 23 Jun 83) pp 96-102

SERGEYEV, A. V., Applied Physical Problems Scientific Research Institute, Belorussian State University.

[Abstract] This study investigates the possibility of constructing a structurally simple algorithm for determining the parameters of an elastic spherical shell in a liquid that uses the space-frequency processing of the field scattered by the shell. The characteristics of the surrounding medium are assumed to be known. A plane harmonic wave is incident on the shell; the space-frequency distribution of the field scattered by the shell is measured. The proposed algorithm is modeled on an ES1022 computer for a water-filled aluminum shell with  $h/R = 0.02$ . Investigations indicate that



registering the field on a spherical surface concentric with the spherical shell is most effective in terms of measurement error. Figures 3; references: 6 Russian. [282-6900]

UDC 534.23

#### STABILITY OF A METHOD FOR ANALYZING RADIATION PATTERN OF ACOUSTIC RADIATOR WITH NEAR-FIELD PRESSURE MEASUREMENT ERRORS

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 31, No 1, Jan-Feb 85  
(manuscript received 16 Jun 83) pp 111-113

TSUKERNIKOV, I. Ye., All Union Food Industry Machine Building Scientific Research and Experimental Design Institute

[Abstract] Two constraints are derived that facilitate the uniform convergence of the approximate solution of the integral equation for the distribution of the normal component of the oscillatory rate to its exact value. Both constraints are derived as the result of linearizing hydrodynamic equations, and therefore can be viewed as a stability criterion for the solution of the equation of the first kind in linear acoustics. It is shown by solving test problems that the algorithm presented in a previous study by the author for solving the integral equation satisfies both constraints automatically. The findings are illustrated by calculating the radiation pattern of an antenna consisting of five phased point acoustic sources spaced with a period of  $\lambda/4$  on the axis of rotation of the measurement cylinder surrounding the antenna. Figures 2; references: 8 Russian. [282-6900]

UDC 534.26

#### REFLECTION OF SOUND FROM PLATE CONTAINING PERIODIC INHOMOGENEITIES

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 31, No 1, Jan-Feb 85  
(manuscript received 7 Apr 83) pp 73-76

LAPIN, A. D., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences.

[Abstract] An elastic wall consisting of a thin plate with small periodic irregularities is investigated in order to study the transfer of energy from bulk waves to surface waves during the incidence of sound on an inhomogeneous wall. The problem of conversion of a bulk wave to a surface wave on a bounded inhomogeneous section is obtained by combining 'free' and 'constrained' solutions for an infinite periodic structure. The problem of the reflection of a bulk wave from an infinite plate with sinusoidal inhomogeneities is found

by the coupled mode method, in which the field is sought in the form of the infinite sum of Bragg spectra. References 4: 3 Russian, 1 Western.  
[282-6900]

UDC 534.6.08

SPECTRUM OF SIGNAL RECEIVED BY MOVING RECEIVER IN UNDERWATER ACOUSTIC CHANNEL

Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 31, No 1, Jan-Feb 85  
(manuscript received 30 Jul 83) pp 22-26

VIROVLYANSKIY, A. L., SAICHEV, A. I. and SLAVINSKIY, M. M., Applied Physics Institute, USSR Academy of Sciences.

[Abstract] The influence of movement of the receiver on the spectrum of an audio signal in an underwater acoustic channel is discussed. Conditions are found under which the spectrum of the received signal can be used to judge the mode structure of the wave, the average velocity of the receiver, and the amount in nature of velocity fluctuations. A preliminary analysis is made of spectral line broadening that makes it possible to provide a quantitative criterion for the dominant mechanism underlying velocity fluctuations, which determines the width of the spectral line. The spectrum of the received signal is found to be characterized by four basic frequencies: the general Doppler shift of the spectrum, broadening of the spectrum because of differences in the frequencies of all of the modes registered by the receiver, the interval between adjacent mode frequencies and broadening of spectral lines due to receiver velocity fluctuations. References 6: 5 Russian, 1 Western.  
[282-6900]

UDC 541.14

INFLUENCE OF IONIZING RADIATION ON OPTICAL AND PARAMAGNETIC PROPERTIES OF YTTRIUM ALUMINUM GARNET SINGLE CRYSTALS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 13 Aug 83) pp 1041-1044

MINKOV, B. I., NIKOLOVA, E. P., TIMAN, B. L., GEGUZINA, S. Ya. and  
KORNIYENKO, V. A.

[Abstract] The influence of iron, chromium and molybdenum impurities on the formation of radiation-induced color centers and paramagnetic centers and heat-stimulated luminescence in YAG and YAG:Nd is investigated. The crystals were radiated by UV, X-ray and  $\text{Co}^{60}$   $\gamma$ -quanta at 77 and 300 K. The EPR spectra were measured by a JES-ME-3X spectrometer at 9.3 and 24 GHz at temperatures ranging from 77 to 473 K. Two types of hole centers are observed, depending upon uncontrollable impurities and the presence of an activator. The relationship between the radiation centers and the change in the charge state of the impurity ions during irradiation is determined. It is found that the presence of molybdenum in YAG does not result in the formation of paramagnetic centers or color centers. Figures 2; references 7: 5 Russian, 2 Western.  
[246-6900]

UDC 541.57:546.49

ELECTRON STRUCTURE OF HALIDE COMPLEXES OF URANYL CONSIDERING SPIN-ORBITAL INTERACTION

Minsk DOKLADY AKADEMII NAUK BSSR in Russian, Vol 29, No 2, Feb 85  
(manuscript received 22 Dec 83) pp 137-140

BORKOVSKIY, N. B. and LYUDCHIK, A. M., Applied Physics Problems Scientific Research Institute, imeni A. N. Sevchenko

[Abstract]  $\text{UO}_2\text{F}_5^{3-}$ ,  $\text{UO}_2\text{Cl}_4^{2-}$  and  $\text{UO}_2\text{Br}_4^{2-}$  ions are analyzed with allowance for spin-orbit interaction by extended Huckel calculations employing the

Mulliken-Wolfsberg-Helmholz approximation for the off-diagonal elements of the Hamiltonian matrix. It is found that the allowance for spin-orbit interaction in the analytical scheme led to no change in the interpretation of the first electron transition as compared with the nonrelativistic case. The linear relationship proposed elsewhere between the parameter  $\alpha_0$  and the distance  $R_{U-O}$  remains valid; the joint influence of the spin-orbit interaction and ligand field makes the calculated electron absorption spectrum richer in lines, which makes it possible to explain the nature of the experimental absorption spectrum more fully. Figures 1; references 6: 3 Russian, 3 Western.  
[259-6900]

UDC 538.114.665.61

#### POSSIBLE EFFECTS IN SOLIDS IN SUPERSTRONG MAGNETIC FIELD

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI  
in Russian No 6(148), Nov-Dec 84 (manuscript received 7 Sep 83), pp 16-19

DRUZHININ, V. V., PAVLOVSKIY, A. I. and TATSENKO, O. M., Moscow.

[Abstract] Possible phenomena associated with the action of a magnetic field with strength of up to  $10^7$  G on condensed matter are analyzed theoretically. Magnetocaloric and negative magnetocaloric effects are analyzed. The disappearance of exchange interaction between conductivity electrons is predicted, as are changes in crystal symmetry, abrupt changes in the optical properties of crystals and the possibility of lasing at frequencies close to the optical band. Figures 1; references 12: 9 Russian, 3 Western.  
[264-6900]

# CONVERSION OF ELECTROMAGNETIC WAVE ENERGY TO ELECTRICAL CURRENT BY BULK SUPERLATTICE SEMICONDUCTOR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 3, Nov 84  
(manuscript received 15 Mar 83) pp 606-608

KECHIYEV, M. M., KOSTENKO, A. A., KUREK, V. D., KUZNETSOV, O. A.,  
TOLOMASOV, V. A., FILATOV, O. N., KHLOPOV, G. I. and SHESTOPALOV, V. P.,  
academician, Ukrainian SSR Academy of Sciences; Radio Physics and Electronics  
Institute, Ukrainian SSR Academy of Sciences; Gor'kiy Physical-Technical  
Research Institute, State University imeni N. I. Lobachevskiy.

[Abstract] This study describes the experimentally observed phenomenon of conversion of millimeter-band electromagnetic wave energy to direct current by bulk superlattice semiconductors. The specimens investigated consisted of multilayer heteroepitaxial structures consisting of three hundred layers of pure germanium and a solid solution of germanium and silicon, alternating with a period of 175 Å. The voltage-power sensitivity of the specimen is analyzed as a function of the electrical dc bias and the microwave power level, and the equivalent noise power is found as a function of the electrical dc bias. Analogous experiments were made for comparison using commercially produced type D404 microwave diodes, confirming a fundamental difference between the semiconductors in question and semiconductor devices with gate-type response. Figures 2; references 9: 8 Russian, 1 Western.  
[162-6900]

UDC 537.572

# CAUSE OF OCCURRENCE OF HIGH-ENERGY IONS DURING UV LASER IRRADIATION OF MOLECULAR CRYSTALS

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 8 Sep 83) pp 2270-2274

YEGOROV, S. Ye. and SHIBANOV, A. N., Spectroscopy Institute, USSR Academy of Sciences.

[Abstract] High-energy ions (up to several keV) form during pulse laser irradiation of the surface of solids at intensities of  $10^4$  to  $10^6$  UV W/cm<sup>2</sup>. It is shown that high ion kinetic energy is associated with the occurrence of a potential on the surface of the specimen due to the external photoelectric effect. The investigations were performed on a transit-time mass spectrometer coupled with a storage oscilloscope with 50 MHz range. The behavior of anthracene and adenine ions is compared. It is found that ions formed near the surface of the crystal in the center of the irradiated area acquire significantly more additional energy than ions formed away from the

center of the irradiated area. The conclusion reached elsewhere that ions where high kinetic energies cannot be formed in the gaseous phase is refuted. Figures 2; references 9: 5 Russian, 4 Western.  
[151-6900]

#### OPTOACOUSTIC INVESTIGATION OF NONLINEAR ABSORPTION OF ULTRAVIOLET LASER RADIATION IN ALKALI-HALIDE CRYSTALS DURING GENERATION OF NONEQUILIBRIUM CARRIERS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI in Russian Vol 88, No 1, Jan 85 (manuscript received 13 Apr 84) pp 21-29

GORSHKOV, B. G., DOROZHKIN, L. M., YEPIFANOV, A. S., MANENKOV, A. A. and PANOV, A. A., General Physics Institute, USSR Academy of Sciences

[Abstract] The amplitude of the acoustic wave that occurs when ultraviolet laser radiation is absorbed in alkali-halide crystals is investigated as a function of the intensity of that radiation. The third and fourth harmonics of a Q-modulated YAG:Nd<sup>3+</sup> laser ( $\lambda=0.35$  and  $0.27 \mu\text{m}$ ) were employed, with selection of transverse and longitudinal oscillations. The specimens were chemically pure single crystals of NaCl, KCl and KBr approximately  $20 \times 20 \times 30 \text{ mm}^3$ . Analysis of the findings indicate that two-photon absorption (zone-zone) was realized, rather than cascade impurity ionization. The optoacoustic experimental method is simple, reliable and sensitive, and can be used over a wide range of radiation intensity. Figures 4; references 23: 10 Russian, 13 Western.  
[266-6900]

#### EVIDENCE OF FERROELECTRIC TRANSITION IN $\text{KTiOPO}_4$ CRYSTALS

Leningrad PIS'MA V ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 11, No 2, 26 Jan 85 (manuscript received 4 Oct 84) pp 85-89

LEONOV, A. P., VORONKOVA, V. I., STEFANOVICH, S. Yu. and YANOVSKIY, V. K., Scientific Research Physical-Chemical Institute imeni L. Ya. Karpov

[Abstract] Investigations are described that provide evidence of the existence of apphase transition to the centrally symmetrical state near 1170 K in  $\text{KTiOPO}_4$  single crystals that can be interpreted as a ferroelectric transition. The polar properties of the crystals were examined over a wide range of temperatures by means of second-harmonic radiation from a YAG:Nd laser. The currently defined linear nature of the behavior of the intensity of the second harmonic near the phase transition point indicates that a ferroelectric phase transition of the second kind is occurring. The confirmation of the ferroelectric nature of the properties of the crystals in question provide a natural explanation for the unusually high optical non-linearity for linear pyroelectrics. Figures 2; references 6: 2 Russian, 4 Western.  
[270-6900]

PROPAGATION OF NONEQUILIBRIUM ACOUSTIC PHONONS IN SOLID SOLUTIONS OF ALUMINUM-BASED GARNET

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI in Russian  
Vol 88, No 1, Jan 85 (manuscript received 6 Jul 84) pp 294-299

IVANOV, S. N. and KHAZANOV, Ye. N., Radio Engineering and Electronics  
Institute, USSR Academy of Sciences

[Abstract] The propagation of nonequilibrium phonons in solid solutions of aluminum-based garnet is investigated by studying phonon kinetics (the "heat pulse" method). It is found that nonequilibrium phonons injected into a garnet lattice propagate mostly in a quasi-diffusional manner for values of the power scattered by the heater ranging from  $10^2$  to  $10^4$  watts per square centimeter. An anomaly in the propagation of nonequilibrium phonons is discovered for concentrations of approximately 25% of rare earth metals replacing yttrium atoms. This anomaly is interpreted qualitatively on the basis of the model of random distribution of mutually substituting Y and R atoms with respect to the corresponding nodes of the crystal lattice. Figures 5; references 15: 10 Russian, 5 Western.  
[266-6900]

OPTICAL ANOMALIES IN PROUSTITE DURING FIRST-ORDER STRUCTURAL PHASE TRANSITION

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian  
Vol 41, No 3, 10 Feb 85 (manuscript received 7 Sep 84) pp 87-89

BAYSA, D. F., KOLENDRITSKIY, D. D. and MAL'TSEV, S. V., Physics Institute,  
Ukrainian SSR Academy of Sciences

[Abstract] The behavior of proustite specimens irradiated by white light is investigated. The findings suggest that a superlattice forms in proustite single crystals due to first-order structural phase transition. The period of the lattice is estimated at 500 nm. It is suggested that such crystals can be used to generate waves in the submillimeter band at temperatures below the first-order phase transition. The deflected beam effect observed is strong enough to permit the phenomenon to be used to control a laser beam. Figures 2; references: 4 Russian.  
[313-6900]

UDC 621.039.5:532.5

HYDRODYNAMICS OF LIQUID-VAPOR DISPERSE ANNULAR FLOWS IN CHANNELS CONTAINING BUNDLES OF HEATED RODS UNDER NONSTEADY-STATE CONDITIONS

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 5, Sep-Oct 84  
(manuscript received 18 Apr 83) pp 933-940

KROSHILIN, A. Ye., KROSHILIN, V. Ye. and NIGMATULIN, B. I., "Energiya"

[Abstract] A one-dimensional nonsteady-state hydrodynamic model is developed for liquid-vapor disperse annular flows in channels containing bundles of heated rods, (e.g. water-cooled nuclear fuel rods). The cross-section of the channel is divided into cells; continuity equations are derived for the gas-phase, liquid-film and droplet components of the mixture. A system of linear algebraic equations is derived for the unknown crossover flows and the pressure gradient along the channel. The model is used to predict the time between the drying up of the fluid layer near a heated rod and the onset of a heat release emergency, and the results agree satisfactorily with experimental findings. Figures 5; references 9: 7 Russian, 2 Western.  
[164-6900]



UDC 533.9

INFLUENCE OF INITIAL SPATIALLY INHOMOGENEOUS TEMPERATURE PERTURBATIONS ON  
VIBRATIONAL RELAXATION DYNAMICS

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI in Russian  
No 6(148), Nov-Dec 84 (manuscript received 10 Aug 83) pp 77-80

KIRILLOV, I. A., POTAPKIN, B. V., RUSANOV, V. D., STRELKOVA, M. I. and  
FRIDMAN, A. A., Moscow.

[Abstract] Vibrational-translational relaxation dynamics in nonequilibrium molecular gas are analyzed with allowance for spatially inhomogeneous perturbations of the translational temperature. It is found that an increase in such perturbations results in the development of high temperature gradients which, in turn, can either increase or decrease the relaxation rate on the average. It is suggested that spatially inhomogeneous vibrational relaxation may be associated with the decay of the high pressure discharge along individual filaments extending along the flow of gas. Figures 3; references 5: 4 Russian, 1 Western.  
[264-6900]

UDC 533.92

IONIZATION EQUILIBRIUM IN HIGHLY NONIDEAL PLASMA WITH CONDENSED DISPERSE  
PHASE

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 5, Sep-Oct 84  
(manuscript received 6 Jun 83) pp 833-840

ZHUKHOVITSKIY, D. I., KHRAPAK, A. G. and YAKUBOV, I. T.

[Abstract] This study presents a classification of the states of plasma with condensed disperse phase in terms of the interparticle interactions parameter. The Wigner-Seitz cell method is employed for small-radius particles and the electrons they emit in the case of weak screening. The analysis of large-particle radii and charge renormalization for strong screening is described. The findings for weak and strong screening are

extended to polydisperse particle systems in which the particles have different dimensions and yields. Figures 4; references 16: 7 Russian, 9 Western.  
[164-6900]

UDC 533.952

#### FORMATION OF MICROPINCHES IN HIGH-CURRENT LINEAR Z-PINCH WITH PULSED GAS INJECTION

Moscow FIZIKA PLAZMY in Russian Vol 10, No 5, Sep-Oct 84  
(manuscript received 1 Dec 83 after revision) pp 1051-1057

ALIKHANOV, S. G., VASIL'EV, V. I., KONONOV, E. Ya., KOSHELEV, K. N., SIDEL'NIKOV, Yu. V. and TOPORKOV, D. A., Atomic Energy Institute imeni I. V. Kurchatov; Spectroscopy Institute, USSR Academy of Sciences.

[Abstract] Micropinch processes in z-pinches with pulsed injection of gas are investigated with gas 'accumulating' between the electrodes with discharge currents of up to 1.1 MA. The influence of the initial gas distribution in the discharge on the effectiveness of micropinch development is investigated. Kr XXXV-Kr XXXVI transitions are observed in the micropinch spectrum with ionization potentials of approximately 17 keV, suggesting that the electron temperature in the micropinch can be as high as 3-5 keV. Optimum plasma formation and compression conditions can be obtained by varying the parameters of the symmetrical gas cloud. The phenomenon is interpreted as being very similar to the formation of plasma points - micropinches in low-inductance vacuum sparks - which are described well quantitatively and qualitatively by the radiation compression model. Figures 6; references 11: 5 Russian, 6 Western.  
[120-6900]

UDC 533.952

#### DYNAMICS OF CYLINDRICAL z-PINCH

Moscow FIZIKA PLAZMY in Russian Vol 10, No 5, Sep-Oct 84  
(manuscript received 23 Aug 83) pp 1045-1050

SOLOV'EV, L. S., Atomic Energy Institute imeni I. V. Kurchatov.

[Abstract] Steady-state configurations of a cylindrical plasma flow are investigated within the framework of two-fluid relativistic electromagnetic gas dynamics; nonlinear radial oscillations of a plasma cylinder with longitudinal current are investigated within the framework of classical single-fluid magnetogasdynamics. The investigations of cylindrical equilibrium and radial oscillations provide a qualitative idea of the

behavior of plasma in a z-pinch during the initial stage of compression and expansion. References 7: 6 Russian, 1 Western.  
[120-6900]

UDC 533.915.03:621.378.324

# TOWARD A THEORY OF ATOMIC GAS BREAKDOWN BY LASER RADIATION NEAR A METAL SURFACE

Moscow FIZIKA PLAZMY in Russian Vol 10, No 5, Sep-Oct 84  
(manuscript received 10 Oct 83) pp 1025-1032

VOROB'EV, V. S. and KHOMKIN, A. L., High Temperature Institute, USSR Academy of Sciences.

[Abstract] The threshold intensity of laser radiation causing the breakdown of atomic gases near a metal surface is investigated as a function of the kind of metal and gas, pressure and radius of focusing spot. The initial stage of breakdown is viewed as a clearly defined transition from the state of a gas with a very low degree of vapor ionization to a state with considerable ionization. This transition is determined by the relationship between the generation of electrons in ionization events and diffusion losses. The average electron energy and diffusion loss radius are found through two-dimensional balance equations written for a cylindrical geometry at a given surface temperature with allowance for the process of ionization and recombination, ambipolar diffusion, heat conductivity, elastic and nonelastic electron energy loss, and absorption of laser radiation energy. The laser radiation intensity is found for which ionization and recombination processes predominate over diffusion losses near the surface. The intensities thus derived are compared with experimental data for different gases and metals. Figures 4; references: 16 Russian.  
[120-6900]

# INFLUENCE OF CESIUM ADMIXTURE ON FORMATION OF INVERSE POPULATIONS IN RECOMBINING LITHIUM PLASMA

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI in Russian No 6(148), Nov-Dec 84 (manuscript received 20 Sep 83), pp 10-15

BOGACHEVA, S. P., VORONYUK, L. V., ZAPESOCHNYY, I. P., STARODUB, V. P. and FEDORCHENKO, A. M., Kiev.

[Abstract] The level populations of lithium are analyzed numerically with allowance for the complex influence of a slightly ionized Cs admixture on the level population of lithium atoms due to changes in the plasma parameters Ne and Te, as well as the reaction of inelastic atomic collisions. It is found that a weakly-ionized cesium admixture increases the inverse populations in lithium over a short relaxation time interval; however, recombination in the plasma is then degraded, and the lithium level population becomes smaller. The gain for the optimum concentration of cesium is significantly greater than  $10^{-2} \text{ cm}^{-1}$ , which constitutes levels entirely sufficient to implement a  $3s \rightarrow 2p$  Li-Cs recombination laser. The inverse population increases almost linearly with the growth in the Li-Cs plasma concentration, so that even higher gains can be achieved by increasing the density of the plasma. Figures 5; references 18: 13 Russian, 5 Western.  
[264-6900]

# INITIAL PLASMA FORMATION DURING EXPOSURE OF ABSORBING MATERIALS TO LASER RADIATION WITH PLANE EXPANSION GEOMETRY OF THE FORMING PLASMA

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85 (manuscript received 30 Dec 83) pp 55-61

MIN'KO, L. Ya., CHIVEL', Yu. A. and CHUMAKOV, A. N.

[Abstract] This study describes experimental investigations of unsteady processes of initial plasma formation, and analyzes the role of erosion and air plasma in the formation of the screening plasma plane. Complex experiments employing high speed shadow, photographic and spectrographic methods, as well as photoelectric recording of the incident and reflected laser radiation, were conducted. A Q-modulated neodymium glass laser producing from 10 to 700 MW/cm at  $\lambda = 1.06 \mu\text{m}$  ( $\tau \sim 10^{-6} \text{ s}$ )<sub>2</sub> was the source of moderate-intensity laser radiation directed at the absorptive targets. The plasma formation times were determined to within approximately 20 ns for aluminum, zinc, bismuth and ebonite. An erosion mechanism is found to describe initial plasma formation; the screening of the target that may develop under certain additional conditions does not occur. The initial

formation of an erosion laser plasma is found to be accompanied by the occurrence of turbulence that includes the entire plasma formation in many cases, including the moving shock wave front. Figures 4; references: 27 Russian.  
[244-6900]

UDC 533.6.011.72

#### SHOCKWAVES FROM EXTENDED LIGHT DISCHARGES IN AIR

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 1 Dec 83) pp 2283-2286

MANZON, B. M., General Physics Institute, USSR Academy of Sciences.

[Abstract] Shockwaves from extended light discharges in atmospheric air are investigated by shadow photography in order to estimate the amount of laser energy which is converted to shockwave energy, as well as the maximum diameters of the rarified troughs. The experimental setup is described in detail. The shape of the shockwave is found to differ when the discharge propagates along the beam and against the beam. This phenomenon is explained by focusing of the beam in the discharge channel in the former case. Figures 3; references: 9 Russian.  
[151-6900]

UDC 533.21

#### LASER EVAPORATION OF METAL IN GASEOUS ATMOSPHERE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 24 Jan 84 after revision) pp 1555-1561

IGOSHIN, V. I. and KUROCHKIN, V. I., Kuybyshev Branch, Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The gas dynamic processes occurring during laser evaporation of metals in gas with counter pressure in the region of the radiation flux (up to 100 MW/cm<sup>2</sup>) are modeled and analyzed theoretically. The boundary between supersonic gas dynamic and diffusion evaporation modes is established. Evaporation of Al and Fe is analyzed numerically. The presence of a gaseous atmosphere is found to have a strong influence on such gas dynamic parameters of the products of the laser evaporation of condensed matter as rate, density and temperature; it has no affect on the mass consumption of matter per unit of surface area. The gas dynamic parameters of an expanding vapor are established as a function of the external pressure and the flux density of the radiant energy. A relationship is found between the external pressure and the energy flux density. Figures 4; references: 12 Russian.  
[70-6900]

## EXPLOSION IN CONFINED VOLUME OF GAS UNDER INTENSE RADIATION

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКИЙ ФИЗИКИ in Russian  
No 6(148), Nov-Dec 84 (manuscript received 6 Sep 83) pp 108-112

NEMCHINOV, I. V., TRUBETSKAYA, I. A. and SHUVALOV, V. V., Moscow.

[Abstract] The development of a point explosion is investigated on the assumption of infinitely strong losses of energy, with infinite compression behind the wave front. The possibility of increasing the radiant flux from the shock wave front and of obtaining a harder spectrum by confining the gas cloud through which the shock wave propagates is examined. The propagation of a strong supercritical plane shock wave in a confined xenon layer is analyzed as an example. More than half the explosion energy is converted to radiation as the shock wave approaches the boundary of the vacuum; the density of the radiant flux is determined primarily by the hydrodynamic energy flux. The limiting picture is independent of the thermodynamic and optical properties of the working gas. Figures 3; references: 14 Russian.  
[264-6900]

## INFLUENCE OF SOLID STATE OBSTACLES ON RADIATION OF RECOMBINATION LASER PLASMA

Moscow FIZIKA PLAZMY in Russian Vol 10, No 5, Sep-Oct 84  
(manuscript received 21 Sep 83 after revision) pp 999-1009

BOYKO, V. A., BRYUNETKIN, B. A., BUNKIN, F. V., DERZHIYEV, V. I.,  
DYAKIN, V. M., MAYOROV, S. A., SKOBELEV, I. Yu., FAYENOV, A. Ya.,  
FEDOSIMOV, A. I., SHILOV, K. A. and YAKOVLENKO, S. I., Physics Institute  
imeni P. N. Lebedev, USSR Academy of Sciences.

[Abstract] The influence of solid-state obstacles on the separation dynamics of laser plasma is investigated. It is found observationally, analytically and through modeling that obstacles influence the nature of plasma flow by changing such hydrodynamic parameters as the electron density and temperature. A substantial role is played by phenomena associated with shockwaves; it is suggested that an increase in recombination plasma glow behind the shockwave front is observed. Two groups of experiments are described: one with high intensity achieved by focusing the laser pulse sharply within a spot 0.1 - 0.4 mm in diameter; and a second with comparatively low intensity, of less than  $5 \cdot 10^{10}$  W/cm<sup>2</sup>, obtained by focusing the pulse in a line 2 cm long and 200  $\mu$ m wide. It is found that obstacles increase the glow intensity of ion lines at those distances at which recombination level pumping is realized.

The changes in glow intensity occurring during interaction with a cylindrical obstacle can be used to diagnose the electron density by the width of the trough in the glow ahead of the shockwave front. Figures 8; references 19: 16 Russian, 13 Western.  
[120-6900]

UDC 621.039.62.12

#### TRANSITION FROM KINETIC TO GAS DYNAMIC PLASMA CONFINEMENT IN PROBKOTRON

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI in Russian No 6(148), Nov-Dec 84 (manuscript received 6 Dec 83) pp 3-9

MIRNOV, V. V. and PEKKER, M. S., Novosibirsk.

[Abstract] The Fokker-Planck equation is integrated numerically in order to track the behavior of the three-dimensional distribution function  $f(t, z, v, \theta)$  as the steady-state solution is achieved. Ion confinement modes in a gas dynamic trap containing dense plasma and in a classical "probkotron" (mirror reactor) containing a rarefied plasma is compared. The rate of loss, density and effective temperature of the particles are obtained as a function of the injection parameters. Figures 5; references 15: 13 Russian, 2 Western.  
[264-6900]

UDC 551.509

#### ASSESSMENT OF INFLUENCE OF INTERACTION WITH ATMOSPHERE GASEOUS IMPURITIES ON DEGREE OF DISPERSION IN AEROSOLS

Tomsik IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: FIZIKA in Russian Vol 28, No 1, Jan 85 (manuscript received 16 Jan 84) pp 112-114

MATVIYENKO, G. V. and SIROTA, V. G., Leningrad Hydrometeorological Institute

[Abstract] The influence of the choice of a particular aerosol particle size distribution on the rate of heterogeneous effluence of gaseous impurities in the atmosphere is assessed. Five different aerosol particle radius distributions are examined. Approximate and exact formulas are presented for determining the rate of heterogeneous effluence; the parameter expressing the error resulting from using the approximate formula instead of the exact one is tabulated for the five different distribution functions. It is found that the aforementioned parameter is equal to unity for any distributions that lie within a specified region of small radii. Figures 1; references 13: 9 Russian, 4 Western.  
[262-6900]

## MICROSPHERE SORTING METHOD FOR LASER FUSION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 10 Nov 83) pp 1597-1601

DROZHZHIN, V. S. and CHUDINOV, V. P.

[Abstract] Methods for sorting out conditioned hollow glass microsphere targets with diameter-to-wall thickness ratios of approximately 100 are investigated. The probable content of conditioned microspheres in initial batches, the effectiveness of the various methods, and the processing conditions are assessed statistically. The microsphere geometry is measured using a method based on the refractive power of a glass shell, and the microspheres are then sorted by geometry without manual manipulation. The fractions obtained are comprised of microspheres which satisfy the requirements of laser fusion with respect to diameter and wall thickness, with thickness dispersion of about 8%. The technological approach developed is proposed for sorting small groups as microspheres containing shells with 1-percent thickness differences. Figures 5; references 11: 2 Russian, 9 Western.  
[70-6900]

## HYDRODYNAMIC AND SEPARATION CHARACTERISTICS OF PLASMA CENTRIFUGE

Moscow FIZIKA PLAZMY in Russian Vol 10, No 5, Sep-Oct 84  
(manuscript received 29 Mar 83) pp 1040-1044

POTANIN, Ye. P. and USTINOV, A. L., Atomic Energy Institute  
imeni I. V. Kurchatov.

[Abstract] Hydrodynamic phenomena associated with the presence of end surfaces in a plasma centrifuge containing a slightly ionized medium are investigated. Qualitative relationships are found between the plasma dynamic characteristics of the centrifuge and the properties of the plasma and the intensity of the magnetic field. The rate of rotation of the plasma and the Joule and viscous dissipation power are calculated in the primary volume and Hartmann layers. The radial coefficient of separation is calculated, and its relationship with the Hartmann number is found. The equilibrium coefficient of separation is found to be highest for Hartmann numbers of the order of unity. The specific energy losses of the plasma centrifuge are estimated, and the range of optimum Hartmann numbers is determined. It is found that the use of plasma centrifuges for separating isotopes of light elements is preferable. References 25: 12 Russian, 13 Western.  
[120-6900]



# EXCITATION OF NITROGEN JET BY CONTRACTED DISCHARGE SCANNED IN MAGNETIC FIELD

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 1,  
12 Jan 85 (manuscript received 5 Sep 84) pp 25-28

ILYUKHIN, A. A., LIPATOV, N. I., MINEYEV, A. P., MYSHENKOV, V. I.,  
PASHININ, P. P., PROKHOROV, A. M. and SMIRNOV, V. V., General Physics  
Institute, USSR Academy of Sciences

[Abstract] The effectiveness of exciting a nitrogen jet by a contracted discharge scanned by a variable magnetic field in the plane perpendicular to the direction of the stream of gas is investigated experimentally. It is found that the method is effective over a wide range of pressures, and that it provides significant separation between the vibrational temperature and the gas kinetic temperature of the nitrogen. The temperature values achieved indicate that the pumping method is promising for laser mixtures containing nitrogen that employ mixing of partial streams of working gas. The vibrational and translational temperatures of nitrogen pumped through a discharge interval of atmospheric air are measured, revealing a low vibrational temperature, apparently because of nitrogen relaxants in the air mixture. References: 5 Russian.  
[271-6900]

UDC 533.951

# SHORTWAVE OSCILLATIONS OF MAGNETIZED PLASMA FILAMENT WITH INHOMOGENEOUS CURRENT

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 14 Jun 83) pp 192-200

NEKRASOV, F. M., Sukhumy Physical-Technical Institute  
imeni I. N. Bekua.

[Abstract] Bulk small-scale oscillations of a current filament with inhomogeneous parameters are investigated in a plasma in which the collisionless approximation  $\omega > \nu_{ei}$  is satisfied. Expressions are derived for the tensor-operator of the permittivity of the plasma; the quantity  $\hat{\epsilon}_{ik}$  is derived from Vlasov's equation assuming that the Larmor radius of the particles is smaller than the other characteristic dimensions of the plasma and the fields. The occurrence of inhomogeneous current is found to change the structure of the transparent and opaque zones for Alfvén, drift and ion-acoustic oscillations; the changes are shown to increase for a given frequency when going to filaments with smaller density and radius. The occurrence of inhomogeneous current may be the source of instability of shortwave oscillations of 'hot' plasma. References 7: 5 Russian, 2 Western.  
[298-6900]

## ION TEMPERATURE IN FLUX OF HIGH-POWER ELECTRODYNAMIC ACCELERATORS

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 3 Mar 84 after revision) pp 201-205

ARKHIPOV, N. I., ZHITLUKHIN, A. M., SAFRONOV, V. M. and SKVORTSOV, Yu. V.,  
Atomic Energy Institute imeni I. G. Kurchatov.

[Abstract] The energy state of the ion component of a plasma generated by a high-power electrodynamic accelerator is investigated. The ion temperature is found to be fairly high, in the region of  $T_i \sim 1$  keV at directional velocities of  $V = (4 - 7) \cdot 10^7$  cm/sec. The findings indicate that the velocity and radial divergence of the flux are determined by the operating mode of the accelerator; the transverse component of the velocity becomes chaotic when the plasmic interacts with the magnetic field. Figures 4; references 7: 6 Russian, 1 Western.  
[298-6900]

UDC 533.951.8

## ALFVEN INSTABILITIES OF PLANE PLASMA LAYER WITH HOMOGENEOUS ION BEAM

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 2 Apr 84 after revision) pp 211-220

PATUDIN, V. M. and SAGALAKOV, A. M., Novosibirsk State University,  
Altay State University.

[Abstract] The behavior of Alfven perturbations in a plasma with an ion beam with sufficiently high density at the plasma boundaries is investigated for the case of a homogeneous beam, in which the effectiveness of the beam on the plasma layer next to the wall increases significantly. The excitation of Alfven waves in the region near the wall is found to be caused by resonant interaction of the ions in the beams with the waves in the vicinity of the channel walls; strong unstable localization is found to occur only for perturbations with fairly high wave numbers. Moderately attenuating Alfven oscillations are detected in the region of the plasma near the wall; boundary and wall intrinsic oscillations can also be excited by an ion beam if the beam density does not drop off too rapidly toward the periphery of the plasma. A method for finding the eigenvalues near the channel wall is presented. Figures 5; references 13: 12 Russian, 1 Western.  
[298-6900]

## LASER INITIATION OF DISCHARGE OF LOW-INDUCTION VACUUM SPARK

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 28 Mar 84 after revision) pp 254-258

KOLOSHNIKOV, G. V., KOSHELEV, K. N., SIDEL'NIKOV, Yu. V. and CHURILOV, S. S.,  
Spectroscopy Institute, USSR Academy of Sciences.

[Abstract] The initiation of a low-induction vacuum spark discharge during evaporation of the anode material by laser radiation is investigated for the case in which the plasma micropinching is controlled by changing the total amount of matter in the discharge and the geometry of the plasma cloud during the initial stage of the discharge. It is found that laser initiation provides a rather steady micropinch mode when sub-microsecond or longer laser pulses are used. The possibility is demonstrated of controlling the delay of the discharge and the time of occurrence of singularities on the current curve. This makes it possible, inter alia, to obtain micropinching of the plasma when the current is highest, and thus to increase the temperature at the 'hot spot'. Figures 3; references 11: 7 Russian, 4 Western.  
[298-6900]

## TWO-DIMENSIONAL CALCULATION OF CONTINUOUS OPTICAL DISCHARGE

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 2 Feb 84) pp 236-243

GLADUSH, G. G., MAMZER, A. F. and YAVOKHIN, A. N., Atomic Energy Institute  
imeni I. V. Kurchatov.

[Abstract] A two-dimensional continuous optical discharge heated in a laser beam is analyzed theoretically by calculating the temperature field of the plasma jointly with the light intensity distribution in the plasma. A quasi-one-dimensional model is employed that describes the energy balance of the gas in an assigned cylindrical space. The model is analyzed numerically for air and for argon at normal pressure. The numerical experiment indicates that the temperature field of the optical discharge has a decisive influence on the intensity distribution in the beam, and that the plasma characteristics depend little upon the details of the intensity distribution. A laser beam at high power is strongly defocused in the plasma. Figures 6; references 15: 12 Russian, 3 Western.  
[298-6900]

## SURFACE COMBUSTION OF LIQUID FUEL IN STREAM OF GASEOUS OXIDIZER

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 17 Nov 83 after revision) pp 33-38

ZVEREV, N. I. and SMIRNOV, V. N., Moscow.

[Abstract] The combustion of the plane surface of a liquid fuel in a stream of oxidizer in the absence of a longitudinal pressure gradient is investigated. The problem is approached within the framework of boundary layer theory, with a boundary layer occurring near the surface of the fuel in the gas. Within the boundary layer exothermic chemical reactions occur between the fuel vapors and the oxidizer, resulting in the release of energy. The motion induced in the fuel layer and the change in the thermophysical properties of the gas as its composition changes are taken into account, which exerts a significant influence on inter-phase heat- and mass-exchange processes for volatile liquids. Figures 3; references 8: 6 Russian, 2 Western. [263-6900]

## EXPLOSION WAVES GENERATED BY DEFLAGRATION COMBUSTION

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 20 Jan 84 after revision) pp 26-33

GOREV, V. A. and BYSTROV, S. A., Moscow.

[Abstract] This study presents an analytical solution of the problem of the flow of gas ahead of a spherical combustion front propagating at a constant velocity with the combustion products assumed stationary. The problem is also solved for a cylindrical flame bounded above and below by rigid planes. Equations are derived for the flame- and piston-associated movement of gas expanding at a constant rate. The method is advantageous in that it makes it possible to calculate the gas flow for a wide range of flame velocities, ranging from minimal, corresponding to laminar combustion, to approximately 500 m/sec. Figures 3; references 10: 5 Russian, 5 Western. [263-6900]

# NUMERICAL MODELING OF ACCELERATION OF SOLID PARTICLES BY GAS JETS

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian, Vol 20, No 6, Nov-Dec 84  
(manuscript received 4 Jan 84 after revision) pp 94-97

KASIMOV, V. Z. and KHOMENKO, Yu. P., Tomsk.

[Abstract] The process of particle acceleration by a high-speed jet of detonation products is modeled numerically to find the initial velocity and initial position of the particle in the charge cavity for which the final velocity is highest, with an acceptable aerodynamic load level. The expansion of the detonation products is analyzed numerically by S. K. Godunov's method. The gas dynamic problem for known velocity, density and pressure fields is solved, and the motion equations for solid spherical particles are integrated. The findings indicate that numerical modeling is effective for the acceleration of solid particles by gas jets. Figures 3; references: 15 Russian.  
[263-6900]

UDC 533.951.2

# CYCLOTRON ABSORPTION OF ELECTROMAGNETIC WAVES CONSIDERING COULOMB COLLISIONS

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 1 Mar 84 after revision) pp 183-191

ISAKOV, S. B. and TSYTOVICH, V. N., General Physics Institute, USSR Academy of Sciences.

[Abstract] The influence of electron-ion collisions on propagation transverse to the external magnetic field, as well as electro-magnetic wave absorption, are examined for arbitrary relationships between the collision frequency and the relativistic correction to the electron cyclotron frequency. The indices of refraction and optical thicknesses are calculated for transverse propagation of ordinary and extraordinary waves near the first and second harmonics during electron-ion collisions. Both resonant and non-resonant absorption are observed. The findings make possible some qualitative predictions about plasma heating dynamics during the initial pre-ionization stage. The explosive increase in temperature at the resonance center is found to be accompanied by increasing localization of the heated region. References 17: 8 Russian, 9 Western.  
[298-6900]

## INFLUENCE OF STOCHASTIC INHOMOGENEITY ON LOWER HYBRID PLASMA HEATING

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 5 Apr 84 after revision) pp 173-182

OBIROV, B. D. and RUBENCHIK, A. M., Automation and Electrometry Institute,  
Siberian Department, USSR Academy of Sciences.

[Abstract] The structure of the turbulence occurring during lower hybrid plasma heating is analyzed considering fluctuations in density. It is found that a very low density fluctuation level modifies the turbulence spectrum significantly without changing the anomalous pumping absorption, which is accompanied by a strong increase in Landau attenuation. The plasmon attenuation for higher fluctuation amplitudes becomes primarily collision-free, and the effective attenuation of the oscillations increases. As a result, the energy is transferred mainly to fast electrons; the oscillation pumping interval becomes smaller and, consequently, so does the amount of energy transmitted to the ions. Figures 1; references 25: 9 Russian, 16 Russian.  
[298-6900]

## KINETIC EFFECTS IN DECAYING PLASMA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 28, No 1, Jan 85 (manuscript received 10 Oct 83) pp 125-128

NEMTSOV, B. Ye., Radio Physics Scientific Research INstitute

[Abstract] This study investigates the resonant interaction of Langmuir waves with the electrons of a decomposing plasma. It is shown that the sign of the decrement of the Landau attenuation can change, even in the case of a (Maxwellian) plasma in velocity equilibrium with a sufficiently slow rate of decrease in concentration. The study is based on the kinetic equation for the nonequilibrium part of the distribution function. The solution of the equation derived for the Langmuir wavefield is shown to contain a time-varying decrement of the attenuation of the plasma wave.  
Reference: 1 Russian.  
[277-6900]

# INFLUENCE OF BEAM SPACE CHARGE ON OPERATION OF PLASMA GENERATOR (AMPLIFIER)

Moscow KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK in Russian 1984, No 10  
(signed to press 2 Oct 84) (manuscript received 27 Apr 84) pp 8-12

KARBUSHEV, N. I., General Physics Institute, USSR Academy of Sciences.

[Abstract] The interaction between an infinitely thin tubular electron beam and a cold plasma completely filling a circular metal waveguide is examined. An equation is derived for the longitudinal component of the electrical field in a liner approximation. It is found that 'negative mass' instability can occur only when the beam is synchronous with higher waveguide modes, i.e., under specific conditions, such as the use of a beam with pre-modulation at a particular frequency. The influence of the space charge is found to increase as the current becomes larger, and the nature of the interaction between the beam and the plasma becomes similar to anomalous Doppler interaction. References: 7 Russian.  
[296-6900]

# JUMP IN POPULATION OF ION LEVELS AT SHOCKWAVE FRONT IN RECOMBINING PLASMA

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 55, No 2, Feb 85  
(manuscript received 22 Dec 83) pp 379-382

DERZHIYEV, V. I., MAYOROV, S. A. and YAKOVLENKO, S. I., General Physics Institute, USSR Academy of Sciences.

[Abstract] The behavior of the glow intensity of ion lines is investigated as a function of the structure of the shockwave front in the plasma. Recombination pumping of the ion levels ahead of the shockwave front drops because of conductive electron heating; the recombination pumping behind the shockwave front increases due to the jump in plasma density. The ion level population behind the shockwave front is often found to be higher than that ahead of the conductive heating zone. Figures 1; references 12: 10 Russian, 2 Western.  
[300-6900]

## PLASMA STABILIZATION IN LONG EQUILIBRIUM CONFIGURATION TRAP

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85  
(manuscript received 11 Mar 84 after revision) pp 155-162

TRUBNIKOV, B. A., GLAGOLEV, V. M., LAZAREV, S. L. and DOBRYAKOV, A. V.,  
Atomic Energy Institute imeni I. V. Kurchatov.

[Abstract] Plasma stabilization in closed magnetic traps with rounded magnetic surfaces is examined. It is found that the vacuum magnetic well required for stability can be achieved by employing S-shaped magnetic mirrors on the curvilinear elements of the trap such that the stabilizing factor is the combination of the curvature and the field inhomogeneity on the axis. 'S-mirrors' are designed for a long equilibrium configuration ("Drakon") trap. It is found that the use of several S-shaped magnetic mirrors in the curvilinear equilibrium elements makes it possible to achieve stability at the expense of increasing the length of the basic curvilinear element. Figures 6; references 4: 3 Russian, 1 Western.  
[298-6900]

## GAS DYNAMIC MODES OF AEROSOL MICROFLAME IN OPTICAL FIELD

Leningrad ZHURNAL TEKHNIЧЕСКОЙ ФИЗИКИ in Russian Vol 55, No 2, Feb 85  
(manuscript received 17 Jun 84 after revision) pp 319-325

VDOVIN, V. A. and SOROKIN, Yu. M., Gor'kiy State University  
imeni N. I. Lobachevskiy.

[Abstract] This study examines the anomalous low frequency aerosol optical breakdown associated with the occurrence of collective modes in an ensemble of aerosol plasma microflames, when the formation of an elongated plasma region is possible only due to overlap of the plasma foci formed on adjacent aerosol particles. New absorption wave propagation modes are obtained that exhibit features of thermal conductivity as well as a shock process. A model is proposed for the evolution of aerosol optical breakdown in the range of intensities extending from the threshold for collective optical breakdown to those which are realized in experiments employing Q-modulated pulses. Figures 4; references 18: 15 Russian, 3 Western.  
[300-6900]



## EXCITATION OF DISCHARGE IN AIR BY LASER RADIATION

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 55, No 2, Feb 85  
(manuscript received 13 Jun 84) pp 312-318

BUKATYY, V. I., KOBOLOV, A. A. and TEL'NIKHIN, A. A., Altay State University.

[Abstract] Experimental findings on the low-threshold breakdown of air by pulse infrared radiation are analyzed. The dynamics of the formation of the discharge and the properties of the low-temperature plasma that is formed are found to depend strongly upon the parameters of the perturbing radiation. The discharge produced in air by a CO<sub>2</sub> laser is highly nonequilibrium, while that produced by a neodymium laser is quasiequilibrium. The findings indicate that discharge development in the radiation field of the neodymium laser is thermal in nature. Figures 3; references: 17 Russian.  
[300-6900]

## RING FORMATIONS IN CORONA OF FILAMENT EXPLODED BY CURRENT

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI  
in Russian Vol 41, No 3, 10 Feb 85 (manuscript received 28 Dec 84)  
pp 11-114

AYVAZOV, I. K., ARANCHUK, L. Ye., BOGOLYUBSKIY, S. L. and VOLKOV, G. S.

[Abstract] This study describes a series of experiments conducted on the Triton accelerator to clarify the nature of the 'hot spots' that occur as the result of the explosion of filaments in the diodes of high-power relativistic electron beam generators. Time-resolution X-ray photography is used to demonstrate that the occurrence of overheated ring structures is preceded by a stage in which constrictions develop. The findings suggest a process in which a hot plasma is formed at individual points as a result of the compression of the ring formations occurring initially in the corona of the plasma channel during the stage of strongest soft X-radiation. Figures 3; references 11: 10 Russian, 1 Western.  
[313-6900]

## TWO-DIMENSIONAL SELF-SIMILAR PLASMA FLOWS WITH AZIMUTHAL MAGNETIC FIELD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI  
in Russian Vol 41, No 3, 10 Feb 85 (manuscript received 5 Dec 84) pp 97-100

VELIKOVICH, A. L., LIBERMAN, M. A. and SHMAL'TS, R. F., Physical Problems  
Institute, USSR Academy of Sciences; Quantum Optics Institute, Max Planck  
Society, FRG.

[Abstract] The class of problems in ideal magnetohydrodynamics is investigated for purely azimuthal orientation of the magnetic field. A general statement is formulated for the self-similar problem of the expansion of a plasma with a spontaneous azimuthal magnetic field from the focal point of a laser beam. It is shown that a solution can be obtained in explicit analytical form for the case in which the adiabatic exponent of the plasma  $\gamma = 4/3$ . As an example, a simple solution is presented in explicit form that describes the radial expansion of a plasma with an azimuthal magnetic field for which the magnetic field and plasma pressure becomes zero at the spherical boundary. Figures 1; references 6: 3 Russian, 3 Western.  
[313-6900]

UDC 536.46

## AERODYNAMICS AND HEAT EXCHANGE BETWEEN FRONT OF FOREST FIRE AND GROUND LAYER OF ATMOSPHERE

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKIY FIZIKI in Russian  
No 6(148), Nov-Dec 84 (manuscript received 15 Jul 83) pp 91-96

GRISHIN, A. M., GRUZIN, A. D. and GRUZINA, E. E., Tomsk.

[Abstract] The use of simplified equations describing the interaction between the moving front of a forest fire and wind on the ground is validated through the numerical solution of rigorous Reynolds equations for a specific example. The typical temperature, velocity, density and pressure fields in the vicinity of the front of the fire are determined, proving that the front of a flame represents a sort of thermal curtain. The numerical calculations confirm the existence of convective column and plume modes; a curve is plotted that separates these two modes on the plane of the parameters  $Fr$  and  $Q$ . The Byram criterion is shown to agree best with the numerical data for nonsteady-state flows, while Gostintsev's criterion is best for steady-state flows. It is found that the flow in the low-altitude atmosphere can be described by boundary-layer type equations for tree-top fires. Analysis of the temperature profiles indicate that a maximum occurs within the layer next to the ground, which is characteristic of the jet boundary laying in the vicinity of a thermal curtain. Figures 4; references 16: 12 Russian, 4 Western.  
[264-6900]

TOWARD THE THEORY OF RAPID MAGNETIC FIELD EVOLUTION IN TWO-COMPONENT ELECTRON PLASMA

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 41, No 3, 10 Feb 85 (manuscript received 24 Aug 84) pp 85-87

ISICHENKO, M. B., CHUKBAR, K. V. and YAN'KOV, V. V., Institute of Atomic Energy imenk I. V. Kurchatov.

[Abstract] Modification of magnetic field generation due to thermal emf in a plasma containing two-temperature electrons is investigated. It is found that magnetic field generation due to thermal emf in a plasma containing a small group of hot electrons rapidly becomes nonlinear, causing the magnetic field profile to become 'inverted'. References 9: 8 Russian, 1 Western.

[313-6900]

UDC 533.915

HEAT CONVECTION IN FLAME OF PLASMOTRON WITH HOT ELECTRODES

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 2, Feb 85 pp 338-339

PASHATSKIY, N. V. and KRAVCHENKO, I. G.

[Abstract] The thermal convection from the plane of an alternating-current plasmotron employing graphite electrodes is measured by the steady-state calorimetric method. The dimensional parameters of the plasmotron are presented. The thermal flux density is measured using the model of a flat silicate brick and graphite barrier; the total thermal convection transferred from the plasma flame to the barrier is found with the help of a water-cooled copper sectional transducer. The thermal flux density on the axis of the flame is found to drop rapidly as the distance between the ends of the electrodes and the barrier increases. The efficiency of the plasma heating of the plate is found to drop as the distance between the nozzle and the plate increases. The complete text of the article is on file at the All-Union Scientific and Technical Information Institute.

Figures 1.

[321-6900]

# INFLUENCE OF REABSORPTION OF RADIATION ON THERMAL CHARACTERISTICS OF ELECTRIC ARCS IN STREAM OF AIR

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 2, Feb 85  
(manuscript received 11 Nov 83) pp 279-284

PANASENKO, L. N. and SEVAST'YANENKO, V. G., Heat- and Mass-Exchange  
Institute imeni A. V. Lykov, Belorussian SSR Academy of Sciences.

[Abstract] An electric arc in a stream of air is analyzed on the basis of a new method in which allowance is made for radiation transfer. The method of partial characteristics is used to perform frequency integration before solving the gas dynamic part of the problem. Allowing for reabsorption of radiation in the real spectrum reduces the axial temperature in different versions of the problem by 500-2000 K, while the plasma temperature near the channel wall increases by 1000 K. The role of conductive heat flow is insignificant. The divergence of the radiation flux is analyzed as a function of temperature, indicating that the divergence is negative at temperatures between 1000 and 10,000 K. Figures 4; references 9: 8 Russian, 1 Western.  
[321-6900]

UDC 621.3.014.31

# ELECTRICAL ARC IN VORTEX GAS FLOW

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 2, Feb 85  
(manuscript received 21 Nov 83) pp 272-278

BERBASOV, V. V. and ZHUKOV, M. F., Thermal Physics Institute,  
Siberian Department, USSR Academy of Sciences.

[Abstract] An axisymmetrical electrical arc in a rotational gas flow is investigated. A system of dimensionless equations describing the parameters of an axisymmetrical arc discharge is presented. Approximating the electrical conductivity as a function of enthalpy as  $\sigma = \sigma_0 \bar{h}^n$ , a self-similar solution is found for the initial system of equations. The axial component of the electrical field is found to be a monotonically decreasing function in the radial direction; the pressure profile exhibits two minima, one on the axis of the arc and the other near the arc boundary. Figures 4; references: 5 Russian.  
[321-6900]

## INFLUENCE OF PHYSICAL-CHEMICAL PROPERTIES OF GASES ON INTERACTION BETWEEN SHOCKWAVES AND CONVEX CYLINDRICAL SURFACES

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 2, Feb 85  
(manuscript received 9 Nov 83) pp 239-244

GVOZDEVA, L. G., LAGUTOV, Yu. P. and FOKEYEV, V. P., High Temperatures Institute, USSR Academy of Sciences.

[Abstract] The interaction of shockwaves with cylindrical surfaces is investigated in a square shock tube with Mach numbers ranging from 1.5 to 6.0 and initial pressures from 10 to 30 mm Hg. Cylindrical segments with radii 123 mm were employed. Shadowgrams and interferograms of the interaction regions were registered in argon, nitrogen and carbon dioxide, which were used to model different depths of physical-chemical transformations in the gas behind the shockwave. The influence of physical and chemical processes on shockwave interaction is described. The changes occurring in the flow picture are similar to those observed on plane wedges. Figures 3; references 7: 5 Russian, 2 Western.

[321-6900]

## HIGH-TEMPERATURE PHYSICS

### THROWING OF PLANE POROUS LAYERS BY SLIDING DETONATION WAVE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 22 Nov 84) pp 142-145

PAVLOV, Yu. A., STAYER, A. M. and SHTERTSER, A. A., Novosibirsk.

[Abstract] This study investigates the throwing of porous layers of finite thickness by an explosive, as in the explosive application of powdered coatings. A series of experiments was conducted in which porous layers were thrown upward or downward. The thrown materials were PMS-1 powdered copper, and sand with grain fraction of less than 1 mm. It is proposed that the porous layer is accelerated by sliding detonation in two stages, with the powder acquiring velocity behind the front of the shockwave; in the second stage, inasmuch as the powder is compressed in the shockwave to a nearly compact state, the throwing process continues by virtue of a series of acoustic waves. It is concluded that more pulse energy is transferred to a porous mass than to a compact body, perhaps because of the longer acceleration time of the porous layers. Figures 2; references 7: 6 Russian, 1 Western.  
[263-6900]

### MECHANISM UNDERLYING ABLATION OF METALS CAUSED BY EXPLOSION PLASMA

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 6 Jul 83) pp 126-134

POPOV, Ye. G., Dnepropetrovsk.

[Abstract] The gas dynamic and thermophysical phenomena occurring during contact between an explosion plasma and metals are investigated. Metal specimens of iron, copper and aluminum, as well as high-carbon steel, alloyed steels, pig iron and aluminum alloys, were exposed to plasma in a specially designed reusable shock tube. The surface layer of the metal was found to be heated by the plasma to critical temperatures, but the evaporation of the metal was small because of shielding of the surface by vapors. Most of the metal was found to be removed at the end of the interaction due to boiling and atomization of the melt as the pressure dropped. Figures 5; references 18: 17 Russian, 1 Western.  
[263-6900]

# CALCULATION OF FORMATION TIME OF MINIMAL NUCLEUS OF FLAME DURING IGNITION OF EXPLOSIVE MIXTURES BY ELECTRICAL DISCHARGES

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 25 Jan 84 after revision) pp 55-58

LOBYZOV, N. I. and KARMAZINOV, N. M., Moscow

[Abstract] The influence of asymmetry on the formation time of the minimal flame nucleus and the sharpness of the maximum of the curve of the discharge power plotted as a function of time are analyzed from the viewpoint of thermal ignition theory. The electrical discharge is replaced by a point heat source with time-varying power; the surrounding medium during the ignition time is chemically inert. It is found that the formation time of the minimal nucleus depends little upon the rate of energy release in the discharge, and is apparently determined, like the dimension of the minimal nucleus of the flame, by the physical-chemical properties of the explosive mixture. The formation time for hydrogen-air and methane-air explosive mixtures is estimated as an example. The analytical and experimental values are found to agree well qualitatively and quantitatively. References 7: 6 Russian, 1 Western.  
[263-6900]

# FLAME PROPAGATION IN PULSED ACCELERATION FIELD

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 8 Dec 83 after revision) pp 58-61

SAMSONOV, V. P., Cheboksary.

[Abstract] The variation in the velocity and form of a flame initially propagating under weightless conditions in a semi-open tube in a pulsed uniform acceleration field is investigated. Weightlessness is created by dropping a heavy container, within which the reaction tube is held vertically. A camera secured to the container is then used to record the flame. The stability of the flame front is studied. Differences in the change in the flame velocity during upward and downward propagation are explained primarily by different conditions for the development of the flows of cold gas and hot combustion products occurring when the reaction tube is braked, as well as convection currents in the combustion product. Figures 4; references 9: 7 Russian, 2 Western.  
[263-6900]

## STATE EQUATIONS OF EXPLOSION PRODUCTS OF CONDENSED EXPLOSIVES

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 20, No 6, Nov-Dec 84  
(manuscript received 4 May 84) pp 114-126

ZUBAREV, V. P. and YEVSTIGNEYEV, A. A., Moscow.

[Abstract] This review presents a general characterization of the state of the matter behind the detonation wavefront in condensed explosives in high-speed detonation modes. The authors note two basic approaches: compilation of the equations of state of the explosion products in order to solve various practical problems, and derivation of state equations in order to predict the detonation parameters for cases in which there are no experimental data available. The accuracy of both approaches is found to be similar as long as the condition of complete chemical equilibrium is adhered to closely in the "independent" approach. Figures 5; references 52: 27 Russian, 25 Western.  
[263-6900]

## INVESTIGATION OF STRUCTURE AND PROPAGATION LIMITS OF FRONT OF TREETOP FOREST FIRE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85  
(manuscript received 17 Oct 83 after revision) pp 11-21

GRISHIN, A. M., GRUZIN, A. D. and ZVEREV, V. G., Tomsk.

[Abstract] A new statement of the problem of the propagation of a two-dimensional treetop forest fire is developed on the basis of a general mathematical model of forest fires proposed elsewhere by the principle investigator. The forest canopy is assumed to be a complex reacting medium; the heat- and mass-exchange between the front of the fire and the lower tier of the forest and the ground atmospheric layer are taken into account. An approach is proposed for averaging the equations obtained with respect to the height of the forest canopy that simplifies the statement of the problem of the occurrence of propagation of a treetop forest fire. The problem of treetop fire initiation and propagation is solved by computer in a simplified one-dimensional statement. Figures 5; references: 14 Russian.  
[314-6900]



## KINETICS OF SUBTHRESHOLD GLOW AND MICROWAVE CONDUCTIVITY IN GLASS SUBJECTED TO LASER HEATING

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 16 Dec 83) pp 1862-1864

KASK, N. Ye., FEDOROV, G. M., CHOPORNYAK, D. B. and YABOROV, M. T.,  
Nuclear Physics Scientific Research Institute, Moscow State University  
imeni M. V. Lomonosov

[Abstract] The glow and microwave conductivity of K8 and ZhS11 optical glasses exposed to subthreshold radiation from a quasicontinuous neodymium laser are investigated experimentally. The glow signal produced in the K8 glass had the same shape as the laser pulse; in ZhS11 glass the glow is observed to increase and to exhibit a solid spectrum when sufficiently high temperatures are reached ( $t \geq 1400$  K). The glow kinetics in the red and blue regions of the spectrum are the same as the kinetics in white light. The signal grows exponentially until the occurrence of a brightly glowing optical discharge plasma. The kinetics of subthreshold glow and microwave conductivity in ZhS11 glass are compared, revealing that the processes are characterized by different activation energies, apparently resulting from different physical mechanisms. Subthreshold glow investigations indicate that the transmission of excitation to the glow centers is determined by heating as well as photoabsorption of radiation at  $1.06 \mu\text{m}$ . The linear relationship between the glow intensity and the optical flux density indicates that a single laser photon participates in an elementary excitation energy transfer event. Figures 2; references: 10 Russian.  
[100-6900]

## EXPERIMENTAL INVESTIGATION OF STRUCTURE OF FRONT OF TREETOP FOREST FIRE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85  
(manuscript received 17 Oct 83 after revision) pp 21-26

GRISHIN, A. M. and PLYUKHIN, V. V., Tomsk.

[Abstract] The temperature fields and mechanism underlying the transfer of energy from the front of the fire are investigated. The propagation velocity and mechanism are found to be determined mainly by the combustible material content and the wind speed; the experimental findings agree qualitatively with the theoretical results obtained elsewhere. Figures 4; references: 9 Russian.  
[314-6900]

FOCUS MECHANISM UNDERLYING COMBUSTION OF CERTAIN SECONDARY EXPLOSIVES BY  
MONOCHROMATIC LIGHT PULSE

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85  
(manuscript received 11 Jul 83) pp 41-45

STRAKOVSKIY, L. G., Moscow.

[Abstract] The characteristics of focal ignition are analyzed on the basis of an experimental investigation of a TG40/60 compound and Tetryl subjected to a millisecond pulse from a neodymium glass laser. It is found that the ignition of Tetryl and TG40/60 by light pulses at  $1.06 \mu\text{m}$  exhibits a clearly defined focal nature. The process is governed by the heating of absorbing impurities such as soot particles approximately  $10^{-3}$  cm in diameter. At powers exceeding approximately  $10 \text{ kW/cm}^2$ , the heating of these impurities reaches a critical value by the instant of ignition, and the ignition becomes degenerate, causing anomalous behavior of the ignition time. Figures 3; references 14: 13 Russian, 1 Western.  
[314-6900]

OCCURRENCE OF PRESSURE WAVE DURING SPONTANEOUS IGNITION OF GAS AHEAD OF  
FLAME FRONT IN CLOSED VESSEL

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85  
(manuscript received 4 Aug 83) pp 49-53

VODYANIK, V. I. and TARAKANOV, S. V., Severodonetsk.

[Abstract] The basic stages of the propagation of a flame in a closed vessel are analyzed chronologically, starting with frontal combustion, followed by spontaneous combustion and pressure wave formation. The analytical results are tested numerically in a problem of spontaneous ignition and pressure wave formation. The conditions under which spontaneous ignition causes shockwave formation are determined. The peak pressures are found to be significantly higher than the maximum reached during frontal combustion of a gas in a vessel. Evaluation criteria are derived for the possibility of spontaneous ignition, as well as formulas for calculating the shockwave pressure. Figures 2; references: 5 Russian.  
[314-6900]

## STEADY-STATE DETONATION OF CHARGES OF FINITE LENGTH

Novosibirsk FIZIKA GORENIYA I VZRYVA in Russian Vol 21, No 1, Jan-Feb 85  
(manuscript received 9 Nov 83) pp 127-130

ASHAYEV, V. K., DORONIN, G. S. and ZHUCHENKO, V. S., Moscow.

[Abstract] The applicability of the steady-state model to short explosive charges is demonstrated with the help of precision optical recordings. The error sources in the 'free surface' method are analyzed, and the findings of two previous studies are interpreted within the framework of classical conceptions. The studies employed compressed trotyl and octogen in charges 10 and 50 mm long initiated by a shockwave. Steady-state detonation is found for 10 mm. Methods based on measuring the attenuation of the velocity of the shockwave front in the barrier can be used to investigate detonation processes using short charges. Figures 4; references 11: 4 Russian, 7 Western.  
[314-6900]

## LASERS

### HYPERBOLOIDS OF THE 21ST CENTURY

Moscow LENINSKOYE ZNAMYA in Russian 2 Oct 84 p 2

[Interview with G. A. Abil'sitov, director of the Technological Laser Scientific Research Center by Correspondent A. Pankov; date and place not specified]

[Text] Several years ago in the town of Troitska the Technological Laser Scientific Research Center of the Academy of Sciences USSR was organized. In another suburb of Moscow--Shatura--laboratory-production facilities were built for it. G. A. Abil'sitov, candidate of technical sciences, and the center's director tells our special correspondent A. Pankov what this center will be, and what its tasks are.

[Question] Galym Abil'sitovich, the world has learned about quantum optical generators--lasers--relatively recently, but we now are already talking not simply about their use but about their widespread introduction into industry...

[Answer] Although the writer A. Tolstoi told about a sort-of prototype laser--the hyperboloid--in the beginning of the century, the first scientific works concerning the possibility of creating similar devices were published only approximately 30 years ago. The first laboratory equipment appeared in the beginning of the sixties. But their widespread application began immediately. Lasers are used all over now: in electronics and medicine, communication and garment manufacture... The laser beam drills rubies for watches and probes the surface of the moon. Scientists have specific hopes for them in taming the energy of thermonuclear fusion...

Over the past several years the expression "laser technology" has securely entered the lexicon of production workers. The powerful beam of light may cut very hard materials, weld metals, strengthen their surface... The task before scientists is that of expanding scientific-research work with the purpose of satisfying the inquiries of the economy for very different kinds of technological lasers. Our center was created for accomplishing this task.

The production base is only now being created in the city of Shatura, but this does not mean that the center now exists in name only. In the associated "Likhachev Plant", for example, our base laboratory for the application of technological lasers has been created. Close efficient contacts have been established with several enterprises near Moscow.

As our first experiment showed, the possibilities of the laser beam in industry are actually very great. We think that irradiation of the surface of punches raises their durability by two to five times. With this, we can economize on expensive alloyed steel.

By a method of laser thermal processing, one cannot only temper and strengthen the surface, but fuse on various coatings, say, from powders.

[Question] What will your center be like after the base [laboratory] is established?

[Answer] Now the construction is going at full blast, and already at the end of this year we will be ready to accept the first stage from the builders. Installation of all the basics will be completed within two to three years.

Although our center is an academic institution it will, in structure, resemble more contemporary NPO [Scientific Production Organizations]. That it, in it there will be divisions for scientific-research, construction, and experimental manufacturing. We will be able to carry out our ideas as far as preparation of pilot models by which industrial technology may be developed.

In the laboratory buildings we intend at first to locate five test stations. Two of these will be automated laser technology complexes for precision cutting of sheet materials and for thermal hardening of components--very specialized. Both these efforts are extremely important for industry--such operations are found in enterprises of very different branches of the economy. Behind every word of the title is our scientific-technical policy. We understand our task thus: not only develop the lasers themselves, but also the technological process and the technological equipment. And all operations must be automated. This is an absolute necessity. The very essence of technological lasers, their complicated control systems, demands it.

Without automation this equipment is more laboratory than industrial. And between them, as it is said, the distance is enormous. We must reduce this distance to a minimum.

Another of the test stations is also narrow in scope--the development of methods of laser welding of frames and housings. In the future we will try to combine the possibilities of different devices into one so that with its help it will be possible to cut and strengthen and weld all at once.

There is yet another test station: in contrast to those already named, it has a broader focus. There we will conduct research to search for new methods of technological application of lasers. Simply speaking, we need better, more powerful and more economic equipment. And the fifth test station is for studying different fields in pure physics: for example, methods of pumping gas-discharge lasers.

We intend to create a multipurpose experimental facility from 15-20 testing stations for research in very different fields. It may shed light, for

example, on such a future topics as atomic-molecular laser technology. Now, if we use a laser beam heating device for treating materials---it causes melting or evaporation of the material, but by the new method we could selectively act on separate atoms and molecules. It is possible, for example, to stimulate chemical reactions. It has been proposed that we create a model of an industrial installation for the laser synthesis of chemical compounds.

[Question] From what you have said, is it possible to draw the conclusion that your center will not itself produce lasers?

[Answer] From the whole range of lasers in the first stage, we chose those which were most developed and to a large degree their characteristics satisfied the needs of industry. We have decided on three basic types of lasers.

Our scientific-research division is oriented to a complex approach for the solution of problems of the use of lasers in the economy. This is reflected in the structure of its departments and laboratories. The subdivisions of the construction bureau are clearly joined with them.

They will be in construction bureaus and several service sectors. The major one of these is the sector for optical elements, insofar as optics to a significant degree determines progress in the development of laser devices.

[Question] Will your center turn into a purely applied enterprise?

[Answer] No. As an academic organization we must conduct fundamental research, including speculation, and if discoveries of new fields await us on this path, we will find the possibility for their development and financing. However, fundamental research is not an end in itself. We will conduct it from a position of rapid introduction of these developments into industry. But in contrast to the usual scientific production organization, we do not have concrete production requirements for industry; our task is to put out a pilot model which, of course, must work under industrial conditions.

The experiences of the world-famous Electric Welding Institute imeni Patona (nominative after that), are very attractive to us. This is a real academic institute, but thanks to its diversity it may distribute both models of equipment and technological process developments.

It goes without saying that in arranging the large specialized resources which traditional academic institutes do not have, we must cooperate with the physicists for realizing their ideas, for compatible development and creation of complex technological equipment. And already now, at the first stage of our work, our relations with multifaceted academic institutes are very cordial. We will have rich opportunities for experiments and construction developments.

How does it happen sometimes? There is an idea, but no builders or experimental production in order to embody it in metal. And many suggestions of scientists through the years do not result in actual testing and application in practice. Of course the presence of such an organization in the USSR Academy of Sciences, which bridges the gap between fundamental research and its practical realization in the field of laser application, will change the existing situation for the better.

[Question] Today, academic institutes as well as many branch institutes are occupied with lasers. How will interrelationships with them be built? Will there be duplication in work?

[Answer] Our center must become the coordinator in the field of technological laser development. And in the future--not only in those areas about which I have spoken, but also much broader. An all-union seminar on laser technology is based at the center. They conducted the first all-union conference on the application of lasers in machine building.

In one of the new buildings a functioning exhibit is continually in place, where new devices and technological processes will be demonstrated.

As far as duplication is concerned, I think that we will have a clear line of demarcation. There where interests coincide it is possible to work on the same problem together. But in distinction from branch institutes, we must think not only about the present problems but also about the search for fundamental new future topics. This is why already now, in the very beginning of our journey, we look with hope on selective laser technology, at its capabilities for acting on separate atoms and molecules, which maybe will be applicable in the chemical industry and in biochemistry and in biophysics...

We think about the possibility of using lasers for measurement and industrial control. The red beam can measure the sizes of parts, determine distances, survey for roads and canals, equally subdivide large areas of land, etc. With time we will apply lasers for medicine and communications. Thus the horizons before us are truly open to infinity. But the responsibility on us is huge, for the level of laser technology and the rate and breadth of its distribution depend on our work.

12596

CSO: 1862/102

## THE MICROWORLD - CAUGHT IN LASER BEAMS

Vilnius SOVETSKAYA LITVA in Russian 21 Oct 84 p 4

[Article by R. Chesna in the column "The Pulse of Science"]

[Text] Parametric tuneable lasers, which are distinguished by a large output power and ultrashort pulse length, have been created by specialists of the Laser Research Center of Vilnius State University, imeni V. Kapsukas.

...We are in one of the laboratories of the center where the first broadly tuneable femtosecond laser complex has been established. A complex experiment is underway on the study of fast-flowing processes of photosynthesis. One of the lasers send pulses into the molecules under investigation and excites a reaction in them, and another one monitors the changes in them which have occurred under the influence of the laser radiation. The entire process is completely automated: a microcomputer controls it.

"The most complex interatomic and intermolecular processes occur in slices of time which are measured exclusively in small quantities" notes the director of the center, Doctor of Physical-Mathematical Sciences Al'gis Piskarskas. "Such research has only become possible thanks to the creation of these parametric lasers. They deliver powerful light pulses hundreds of femtoseconds in duration. A femtosecond, speaking in layman's terms, is smaller than a second by the same proportion that a second is smaller than thirty million years..."

A. Piskarskas and his colleagues, senior scientific coworkers A. Yuozapavichyus and R. Danelyus, exhibit a small transparent crystal. It turns out that it refracts the laser radiation into all the colors of the rainbow. Up until now, it required dozens of dyes and very expensive optical components to change colors, but now this is done by one crystal. Moreover, it makes it possible to "create" significantly more powerful radiation.

"The work of the scientists led by A. Piskarskas has received worldwide recognition. They have put Vilnius University among the leading laser research centers. This research is now being continued by many Soviet and foreign laboratories," is the praise given by Lenin prize laureate S. Akhmanov, professor at Moscow State University, about the work of those at Vilnius.



The principles developed in Vilnius for high efficiency parametric conversion of the laser beam and, on this basis, the design of broadly tuneable lasers has opened the future for the use of laser devices both in fundamental research as well as in the economy. The penetrating beam is already at work in fiber optic communication systems which increases the volume and speed of the transmission of information by several hundred times. New lasers also help in creation of optical computers, whose capacity surpasses the electronic computer by a thousand times.

The research of the university physicists has been entered in the cycle presented for the 1984 USSR State Prize Competition. Among the well known Soviet scientists who are candidates in the competition for this prize is Al'gis Piskarskas.

12596

CSO: 1862/102

UDC 621.375.8

LASING ON VAPORS OF CHAIN COMPOUNDS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 28,  
No 1, Jan 85 (manuscript received 14 Jul 83) pp 101-103

GRUZINSKIY, V. V., DEGTYARENKO, K. M., KOPYLOVA, T. N. and PAVLOVA, V. T.,  
Belorussian Polytechnical Institute; Siberian Physical-Technical Institute  
imeni V. D. Kuznetsov, Tomsk State University

[Abstract] The lasing properties of a number of organic molecules in the gas phase and in solution are investigated. Effective lasing is achieved on the vapors of new chain-structured organic compounds; replacing a double carbon-carbon bond with a ternary bond improves the lasing characteristics of the active media in the gas phase significantly. Lasing intensity and threshold pumping power density close to the values in a Toluol solution are achieved for 1,4-diphenyl-ethynilbiphenyl. Figures 1; references: 4 Russian. [262-6900]

UDC 621.378.325

ENERGY CHARACTERISTICS OF LASER WITH SATURABLE ANISOTROPIC ABSORBING  
MEDIUM IN CAVITY

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 17 Oct 83) pp 899-904

VOYTOVICH, A. P. and MASHKO, V. V.

[Abstract] The single-frequency steady-state lasing mode of a laser in which the cavity contains an absorbing medium in the longitudinal magnetic field and elements that create circular phase and linear amplitude anisotropy is investigated theoretically. The influence of various factors on the size of the losses introduced in the laser cavity by the absorbing medium, and the corresponding changes in the intensity of the radiation generated at the frequency of the absorption line, are investigated. The relative change in the absorption lines when a magnetic

field is applied to the absorbing medium is calculated as a function of the lasing intensity in the absence of absorption in the cavity. The analytical data show good agreement with experimental values. The findings can be utilized for intracavity laser spectroscopy. Figures 4; references 10: 6 Russian, 4 Western.  
[246-6900]

UDC 621.378.3

#### EFFICIENCY OF $\text{LiF:F}^{2-}$ CRYSTAL LASERS AS FUNCTION OF PUMPING PULSE LENGTH

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 7 Sep 83) pp 904-908

MIKHNOV, S. A. and RAKUSH, V. V.

[Abstract] The efficiency of  $\text{LiF:F}^{2-}$  lasers is investigated in detail as a function of the pumping pulse duration and power. An  $\text{LiF:F}^{2-}$  active element 4 cm long with natural optical density of 1.7 at 1064 nm was employed. Color centers were formed in the LiF crystal by  $\gamma$ -irradiation from a  $\text{Co}^{60}$  source. The active element was pumped by a  $\text{YAG:Nd}^{3+}$  laser. Analysis of the findings indicates that there is a strong relationship between laser efficiency and the pumping pulse duration that must be taken into account in developing  $\text{LiF:F}^{2-}$  lasers. Figures 3; references: 5 Russian.  
[246-6900]

UDC 621.378.4

#### INVESTIGATION OF EFFICIENCY OF GENERATION OF DIFFERENCE-FREQUENCY LASER RADIATION IN WAVEGUIDE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 25 Jul 83) pp 908-911

MAKARYAN, A. O., MOVSISYAN, K. M. and POGOSYAN, P. S.

[Abstract] Millimeter wavelength difference-frequency lasing was obtained by mixing the frequencies produced by two temperature-detuned ruby lasers in a  $\text{LiNbO}_3$  crystal in a rectangular waveguide. The conversion efficiency is studied as a function of the angle of incidence of the exciting beams on the crystal, as well as the angle between the exciting beams and their spatial overlap, at wavelengths of 4 and 8 mm. The experimental findings are in good agreement with the analytical figures. The results can be used in developing lasers, determining the spatial parameters of lasers, etc. Figures 2; references 7: 5 Russian, 2 Western.  
[246-6900]

## INFLUENCE OF EXCITED SINGLET STATES OF MOLECULES ON FOUR-WAVE INTERACTION EFFICIENCY IN DYE SOLUTIONS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 29 Aug 83) pp 911-916

KABANOV, V. V., RUBANOV, A. S., TOLSTIK, A. L. and CHALEY, A. V.

[Abstract] Phase conjugate reflection during degenerate four-wave interaction in dye solutions modeled by a three-level scheme is investigated. The model takes into account the primary 1-2 transition, as well as transitions between excited singlets states 2-3, and can be used to describe the dye when the influence of triplet states can be disregarded. The influence of excited singlet levels on the energy efficiency of phase conjugate reflection is analyzed numerically. Conditions are defined under which conjugate wave generation is possible. It is shown in adiabatic approximation that the thermal nonlinearity caused by nonradiative transitions between excited levels of the dye molecule can have a strong influence on wavefront conjugation energy efficiency when the pumping wave intensity exceeds the saturation intensity of the basic singlet-singlet transition. Figures 4; references 7: 5 Russian, 2 Western.  
[246-6900]

## SPECTRUM STRUCTURE OF XeCl ELECTRIC DISCHARGE LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 4 Oct 83) pp 1029-1032

BURAKOV, V. S., BOKHONOV, A. F., TITARCHUK, V. A.

[Abstract] The influence of selective cavity elements, intra-cavity absorption, plasma reaction products in the active medium, and components of the electrode material on the spectrum structure of an XeCl laser is investigated. The investigations employ high spectral resolution ( $3 \cdot 10^5$ ) with widely varying pressure of the active medium, and cavity construction, in incorporating a selectively absorbing cell, making it possible to identify the basic factors determining the formation of the lasing spectrum. The occurrence of an interference structure is observed experimentally, and ways of eliminating it are found. The possibility of controlling the spectrum with the help of dispersing elements and a selectively absorbing cell is demonstrated. Selective losses induced by the OH radical could not be eliminated. Figures 2; references 7: 4 Russian, 3 Western.  
[246-6900]

# INTERFERENCE OF NINTH-ORDER RESONANT PROCESSES AND SEVENTH-ORDER NONRESONANT PROCESSES IN GENERATION OF SEVENTH HARMONIC OF NEODYMIUM LASER IN MERCURY VAPORS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 25 Jul 83) pp 122-124

MYSLIVETS, S. A., LUKINYKH, V. F., POPOV, A. K. and SLABKO, V. V.

[Abstract] The interference between seventh- and ninth-order processes is investigated experimentally by determining the relationship between the power of the seventh harmonic ( $\lambda = 153.6$  nm) and the frequency when the pumping frequency is tuned close to eight-photon resonance with a 6S-8S transition. The radiation source was a neodymium glass laser described in a previous study by the authors. It is found that the relationship between the power of the seventh harmonic and the frequency of the converted radiation observed experimentally is explained well by interference between nonresonant seventh- and resonant ninth-order processes. The efficiency of conversion involving higher-order resonant processes can be significantly greater than that for non-resonant lower-order processes. The findings are important for developing nonlinear optics for the vacuum ultraviolet band. Figures 2; references 8: 5 Russian, 3 Western.  
[272-6900]

UDC 621.383.5

# DISTRIBUTED-FEEDBACK LASERS WITH ACTIVE FRAMING MEDIUM

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 17 Oct 83) pp 48-51

RYZHOV, Yu. N., CHEREMISKIN, I. V. and CHEKHLOVA, T. K.

[Abstract] This study describes the use of transverse waveguide pumping in thin-film layers employing an active framing medium. With this approach, active particles are excited only in the thin framing layer of the waveguide, which reduces the superluminescence and lasing (non-waveguide) that occurs within the pumped layer. A laser consisting of a  $0.06 \mu\text{m Ta}_2\text{O}_5$  film applied to a glass substrate is described. The method by which the active stripline waveguides were prepared is described. The relationship between the laser gain and the waveguide parameters is investigated theoretically, and the laser parameters corresponding to the smallest threshold pumping power are found. The use of alkali-halide crystals with color centers to obtain CW lasing is discussed. The distributed feedback lasers examined require high pumping power desntiy and give off substantial heat in the CW mode. Figures 3; references 4: 3 Russian, 1 Western.  
[244-6900]

# INVESTIGATION OF POLARIZATION CHARACTERISTICS OF RADIATION FROM LASER WITH DYE-ACTIVATED POLYMER ELEMENTS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 24 Oct 83) pp 35-40

BURAKOVA, V. S., VASIL'EV, N. N., GORELENKO, A. Ya., SIVENKOVA, V. Ye. and SHKADAREVICH, A. P.

[Abstract] The polarization characteristics of a laser with active elements made of oxazine-17 activated polymethylmethacrylate are investigated and compared with the analogous parameters of a laser employing solutions of oxazine-17 in different solvents. The influence of the activator on the properties of the polymer elements activated by complex organic compounds is assessed. The lasing efficiency and degree of polarization during transverse and quasi-longitudinal excitation at the second harmonic (532 nm) of a frequency monopulse YAG laser are determined as a function of the azimuth of the polarization, the power of the exciting light and the parameters of the cavity of the dye laser. The properties of polymer lasers are found to depend more upon the polarization of the exciting light than dye lasers, which is important when polymer elements are employed in tunable lasers. The intrinsic anisotropy of the polymer is found to be the fundamental factor determining the efficiency in polarization of the laser. Figures 3; references 11: 10 Russian, 1 Western.  
[244-6900]

# HIGH-EFFICIENCY $\text{Al}_2\text{O}_3:\text{Ti}^{3+}$ TUNABLE LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 17 Jul 84) pp 126-128

KRUGLIK, G. S., SKRIPKO, G. A., SHKADAREVICH, A. P., KONDRATYUK, N. V., ZHDANOV, E. A. and ZABAZNOV, A. M.

[Abstract] This study investigates the lasing characteristics of laser-driven  $\text{Al}_2\text{O}_3:\text{Ti}^{3+}$  crystals. The experiments were conducted with crystal specimens with 60-degree orientation of the optical axis and having working lengths ranging from 1 to 80 mm. The excitation source was the second harmonic of a GSGG laser. The lasing energy (~800 J) and efficiency (36%, with up to 56% differential efficiency) for a specimen 50 mm long were found to depend little upon the coefficient of reflection of the output mirror over a fairly wide range of variation. The maximum possible tuning range was determined by studying a cavity 200 mm long with TF-fiberglass prism serving as the selecting element. Tuning was achieved over the 680-930 nm range. Second harmonics were generated with  $\text{LiIO}_3$  crystals, and passive

Q-switching was realized with  $F_2^-$  color centers in the LiF crystal.  
Figures 3; references: 3 Western.  
[244-6900]

UDC 621.378.325

#### ULTRAVIOLET LASING IN HELIUM-NITROGEN MIXTURES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1,  
Jan 85 (manuscript received 21 Oct 83) pp 131-134

ASINOVSKIY, E. I., VASILYAK, L. M., MARKOVETS, V. V. and TOKUNOV, Yu. M.

[Abstract] The influence of helium admixtures on ultraviolet lasing (337.1 nm) in a coaxial nitrogen laser is investigated experimentally. The addition of helium expands the region of pressures within which lasing exists, but the lasing intensity drops off. An experimental setup incorporating a glass discharge tube 48.5 cm long and 0.4 cm in diameter is described. Lasing in coaxial lasers is found to be determined basically by the dynamics and parameters of the breakdown waves, regardless of the composition of the gas. The addition of helium makes it possible to increase the overall working pressure of the gas in a nitrogen laser without reducing the peak power of the laser significantly. The laser pulse length is shorter in helium-nitrogen mixtures than in pure nitrogen. The length of the tube must be increased or decreased correspondingly in order to obtain the first or second laser peak for a given pressure. Figures 1; references 8: 7 Russian, 1 Western.  
[244-6900]

UDC 621.378.33

#### ELECTROIONIZATION IR Xe-ATOM LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 18 Jan 84) pp 1722-1736

BASOV, N. G., DANILYCHEV, V. A., DUDIN, A. Yu. ZAYARNYY, D. A.,  
USTINOVSKIY, N. N., KHOLIN, I. V. and CHUGUNOV, A. Yu., Physics Institute  
imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A powerful high-pressure electroionization laser employing the 5d-6p and 7p-7s transitions in atomic Xe is investigated. Experiments are described in which a Xe-mixture electron-beam laser with different buffer gases is pumped. The electrical characteristics of the electroionization discharge are investigated for a long pre-ionization pulse. The energy parameters and spectral composition of the output radiation are obtained as a function of the pumping method, the parameters of the discharge loop and

the composition and pressure of the working mixture. Possible mechanisms for the population of the working levels of the laser transitions are discussed. Experiments demonstrate that electron and electroionization excitation methods are effective, and indicate that the absolute and specific output characteristics of high-pressure Xe lasers can be improved significantly by increasing the power of the laser installations, optimizing the pumping modes, and increasing the volume of active medium. In this experiment, electron beam pumping with current density  $\sim 6 \text{ A/cm}^2$  and pulse duration  $0.7 \mu\text{s}$  resulted in lasing energy 6J (efficiency  $\sim 1.5\%$ ), while electroionization pumping resulting in lasing energies near 20J (efficiency of up to 5%) for an active volume of 9l. Figures 7; references 42: 17 Russian, 25 Western.  
[100-6900]

UDC 621.373.826.038.825.4

#### SIZE-QUANTIZATION LEVEL LASER WITH SEPARATE ELECTRON AND OPTICAL LIMITATIONS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 10 May 84) pp 1885-1887

ALEKSANYAN, Al. G., ALEKSANYAN, A. G., MIRZABEKYAN, G. Z. and POPOV, Yu. M.,  
Radio Physics and Electronics Institute, Armenian SSR Academy of Sciences;  
Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] This study examines the use of multilayer structures in semiconductor lasers to retain the energy spectrum of the size-quantized active region within which amplification at the required frequency is achieved. A five-layered symmetrical structure is examined which provides separate electron and optical limitations. The threshold is analyzed as a function of the thicknesses of the active and waveguide regions, as well as the permittivities of the corresponding layers. It is found that the threshold value of the imaginary part of the permittivity for a five-layer structure is three orders of magnitude smaller than that for a three-layer structure. The distributed loss model employed in the study has no significant effect on the results obtained. References 7: 3 Russian, 4 Western.  
[100-6900]



## OPTIMIZATION OF PARAMETERS OF CHEMICAL CO LASER BY INCREASING LENGTH OF ACTIVE MEDIUM

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 14 Dec 84) pp 1883-1884

DUDKIN, V. A. and RUKHIN, V. B., Problems of Mechanics Institute, USSR Academy of Sciences

[Abstract] A  $\text{CS}_2\text{-N}_2\text{O-O}_2$  flame-pumped continuous wave CO laser with active medium up to 3 meters long is investigated experimentally. The vacuum chamber within which the carbon disulfide was burned consisted of three sections 1 meter long connected in series with a burner 1 meter long within each section, making it possible to change the length of the active medium. Since previous studies demonstrated the possibility of mismatch of the transverse dimensions of the active medium and the modes of the optical cavity, particular attention was paid to the type of cavity employed. Chemical efficiency of 15% is achieved with CW laser radiation at about 100 W. The energy characteristics obtained by optimization indicate that CO lasers employing free combustion of carbon disulfide are effective devices for converting chemical energy to laser radiation energy. Figures 2; references 6: 4 Russian, 2 Western.  
[100-6900]

POWERFUL PULSED  $\text{CO}_2$  LASER WITH PLASMA ELECTRODES

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 18 Jan 84) pp 1867-1869

GORKOVSKIY, V. P., KARLOV, N. V., KOVALEV, I. O., KOVAL'CHUK, B. M., KUZ'MIN, G. P., MESYATZ, G. A. and PROKHOROV, A. M., General Physics Institute, USSR Academy of Sciences

[Abstract] An experimental setup is described in which plasma electrodes are created on a substrate of foil-covered glass-cloth-base laminate. It is demonstrated that the plasma sheets formed by a discharge sliding over the surface of the dielectric can serve as a preionization source and as electrodes in atmospheric-pressure  $\text{CO}_2$  lasers. The energy parameters of such a laser with a 150 x 150 mm active medium are as good as those of lasers employing electron-beam preionization. Figures 2; references: 6 Russian.  
[100-6900]

# FREQUENCY MODULATION OF RADIATION OF TWO-COMPONENT INJECTION LASER WITH COUPLED CLEAVED CAVITY

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 15 Dec 83) pp 1859-1862

GOLDOBIN, I. S., LUK'YANOV, V. N., MALAKHOVA, V. I., PROKOF'YEVA, S. P., SOLODKOV, A. F., TAMBIYEV, Yu. A. and YAKUBOVICKH, S. D., Optical-Physical Measurements Institute (A-U)

[Abstract] This study describes measurements of the spectral characteristics of coupled cleaved-cavity ( $C^3$ ) lasers: GaAs strip homolasers and GaAlAs mesa strip heterolasers. The cavities are coupled by precision mounting of the crystals on a common conductor separated by gaps of 2-5  $\mu\text{m}$ . Frequency tuning by changing the injection current in the controlled region of the laser is examined. An inter-mode switching time of less than 100 ns is obtained by microwave-current frequency modulation. Figures 3; references 10: 7 Russian, 3 Western.  
[100-6900]

# FORMATION OF CHARGE AND ENERGY SPECTRUM OF MULTIPLY-CHARGED IONS OF EXPANDING LASER PLASMA

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 12 Dec 83) pp 1854-1856

GOLUBEV, A. A., LATYSHEV, S. V. and SHARKOV, B. Yu.

[Abstract] A comparison is made between experimental data and a hydrodynamic quasi-two-dimensional model of the processes underlying the formation of the energy and charge composition of ions in an expanding laser plasma presented in other studies. The model allows only for an inverse decelerating mechanism of absorption of laser radiation, and is applicable for a plasma created by focused radiation from a  $\text{CO}_2$  laser with pulse length of approximately 100 ns and flux density not exceeding  $10^{12} \text{ W/cm}^2$ . It is found that a hydrodynamic acceleration mechanism, as well as dielectron recombination during the heating stage and ternary recombination in the expansion stage, describe well the experimentally observed energy spectra of ions in an expanding laser plasma. The experimentation was performed with a  $\text{CO}_2$  laser producing pulse energy of 30 J and peak power of  $10^8 \text{ W}$ . The ion component of the expanding plasma was analyzed by a transit-time mass spectrometer and ion current collectors placed at various distances from the target. Figures 3; references: 5 Russian.  
[100-6900]

POWERFUL  $\text{LiJO}_3$  PARAMETRIC OPTICAL OSCILLATOR FOR IR LASER CHEMISTRY

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 25 Jan 84) pp 1847-1850

ASHMARIN, I. I., BYKOVSKIY, Yu. A., UKRAINTSEV, V. A., CHISTYAKOV, A. A. and SHISHONKOV, L. V., Moscow Engineering-Physics Institute

[Abstract] A high-power single-cavity  $\text{LiJO}_3$  parametric optical oscillator for selective action on organic macromolecules is described. In the arrangement employed, short-wave radiation is contained within the cavity, while working radiation at  $2.12 \mu\text{m}$  is output. The quantum efficiency of pumping radiation convergence is plotted as a function of the signal wavelength, in addition to the reflection spectra of the mirrors. It is found that lasing at wavelengths shorter than  $2.7 \mu\text{m}$  is complicated by absorption in the  $\text{LiJO}_3$  crystal, which results in a reduction in the quantum conversion efficiency. The optical breakdown threshold of the  $\text{LiJO}_3$  element is also lowered significantly, apparently because of effective absorption of radiation at wavelengths shorter than  $2.7 \mu\text{m}$ . Experiments on the decomposition of cellulose nitrate are described. The mass spectra obtained for  $2.76$  and  $2.67 \mu\text{m}$  were found to differ significantly. It was found that the parameters of the device permit it to be used to investigate the effect of IR laser radiation on organic molecules in the gaseous and condensed phases.

Figures 3; references: 4 Russian.

[100-6508]

## REGULAR AND STOCHASTIC SELF-MODULATION OF RADIATION IN RING LASER WITH NONLINEAR ELEMENT

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 2 Jan 84) pp 1844-1847

OKULOV, A. Yu. and ORAYEVSKIY, A. N., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A scheme is described for cyclic generation of the second optical harmonic in the traveling-wave mode. The experimental setup consists of a ring laser and a second-harmonic converter which introduces nonlinear losses into the system. It is found that various dynamic modes described by a unidimensional mapping can be achieved by generating the second harmonic in a ring laser. The fact that the proposed system can be implemented experimentally, and the simplicity of its theoretical description, allow it to be viewed as a promising tool for investigating order-disorder transitions in nonlinear dynamic systems. The proposed system is easier to implement than a nonlinear interferometer; there is no interference at the entrance pupil, and the optical length is not critical. Figures 3; references 7: 3 Russian, 4 Western.

[100-6900]

FREQUENCY RESONANCES IN TWO-MODE He-Ne/I<sub>2</sub> LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 27 Sep 83) pp 1807-1811

GONCHUKOV, S. A., KIREYEV, S. V. and PROTSENKO, Ye. D., Moscow  
Engineering-Physics Institute

[Abstract] Frequency resonances of a  $^3\text{He}-^{20}\text{Ne}/^{127}\text{I}_2$  (0.63  $\mu\text{m}$ ) laser producing two parallel polarized modes, employing a traditional linear cavity, are investigated for the first time. Resolution and identification of the frequency resonances are examined, in addition to the values of the frequency resonances and frequency pedestal, and the optimum parameters of the observing medium. It is found that the frequency resonances in these lasers are of approximately the same magnitude regardless of whether the mode polarizations are parallel or linearly mutually orthogonal. Measurement of the signal/noise ratio indicates that the use of frequency resonances in the laser in question is valuable for high sensitivity intra-cavity spectroscopy. Figures 6; references 7: 5 Russian, 2 Western. [100-6900]

UDC 621.373.826

## THERMOOPTICAL DISTORTIONS AND LARGE-SCALE SELF-FOCUSING IN ACTIVE ELEMENTS OF POWERFUL LASER SYSTEMS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 12 Aug 83) pp 1784-1793

TIKHONOV, A. N., ARSENIN, V. Ya., PAVLOV, V. I., PERGAMENT, A. Kh. and  
CHERNYAK, V. M., Applied Mathematics Institute imeni N. V. Keldysh,  
USSR Academy of Sciences

[Abstract] Previously unstudied thermooptical distortion mechanisms, which are important for athermal glasses, are investigated in detail. Deformations of the end surfaces of rectangular and round active elements are investigated. The propagation of powerful laser radiation in an amplifier stage employing a rectangular active element is modeled numerically with allowance for thermal optical distortions and large-scale self-focusing. The use of rectangular active elements makes it possible to achieve total athermality for one of the radiation polarizations. Figures 5; references 26: 23 Russian, 3 Western. [100-6900]

## INFLUENCE OF PUMPING MODE ON LASING IN He-Xe OPTICAL BREAKDOWN PLASMA

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 5 Mar 84) pp 1757-1762

APOLLONOV, V. V., BUNKIN, F. V., DERZHAVIN, S. I., PROKHOROV, A. M.,  
SIROTKIN, A. A. and FIRSOV, K. N., General Physics Institute, USSR Academy  
of Sciences

[Abstract] The characteristics of a He-Xe laser are investigated for a wide range of pumping conditions (varying the energy, pulse duration and working mixture pressure). A CO<sub>2</sub> laser with variable pulse length was employed. Lasing was obtained at  $\lambda=2.03, 2.65, 3.4$  and  $3.65 \mu\text{m}$ . It was found that the relative importance of CO<sub>2</sub> pulse spiking decreases as the pumping length increases. The distance from the target at which the maximum lasing power is observed depends upon the pumping energy and the pressure of the working mixture. A quasicontinuous lasing mode is detected in the optical breakdown plasma. The role of the gas dynamic processes occurring during interaction between the laser radiation and the gas in the vicinity of the target during inversion formation is discussed. Figures 7; references 10: 9 Russian, 1 Western.  
[100-6900]

## EFFICIENCY OF OPTICALLY-PUMPED XeF-LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 15 Feb 84) pp 1750-1756

ZUYEV, V. S., MIKHEYEV, L. D., STAVROVSKIY, D. B., Physics Institute  
imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A discussion is given of the findings from experiments conducted to determine the attainable inner efficiency and technical efficiency values for a photodissociation XeF-laser employing electrical-discharge vacuum UV pumping. The laser investigated employed B-X (353 nm) and C-A (485 nm) transitions in the Xe-F excimer. The possibility of attaining instantaneous efficiency of approximately 1% in discharge-pumped XeF-lasers is confirmed experimentally. The energy efficiency, defined as the ratio of the lasing energy to the energy stored in the condenser battery, can also approach 1%. It is estimated that only about 10% of the energy emitted by the source within the photodissociation band of XeF<sub>2</sub> is utilized, considering the temporal behavior of the brightness temperature and the geometric dimensions of the pumping source. The output energy observed is the highest ever recorded for optically pumped XeF lasers. Figures 1; references 18: 12 Russian, 6 Western.  
[100-6900]

# INVESTIGATION OF VARIATION IN ANGULAR DIVERGENCE OF RADIATION FROM HELIUM-NEON LASER ( $\lambda=3.39 \mu\text{m}$ ) AS FUNCTION OF DISPERSION CHARACTERISTIC OF ACTIVE MEDIUM

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 12 Jan 84 after revision) pp 1692-1694

ASTAKHOV, A. V., GORLOV, Yu. V., MUKHAMEDGALIYEVA, A. F. and NIKITIN, V. V.,  
Moscow Mining Institute.

[Abstract] The angular divergence of the radiation from a helium-neon laser ( $\lambda=3.39 \mu\text{m}$ ) is investigated as a function of variation in the output frequency within the active medium gain profile. The laser beam is split into two beams, one with a long and one with a short optical path. The frequency was adjusted by thermal expansion of the laser cavity, making the change in frequency proportional to the heating time of the cavity. The effect is most pronounced for the beam with the longer optical path length. The maximum relative change in the angular divergence is  $4 \pm 2\%$ . It is established that the angular divergence changes because of nonlinear frequency variation of the index of refraction of the active medium in the region of Doppler broadening of the gain line which, in turn, is due to saturation by the strong field within the optical cavity. Frequency variation of angular divergence must be taken into account in designing laser gas analyzers in order to improve the accuracy of the analysis. Figures 2; references: 1 Western.  
[70-6900]

# HELIUM-EUROPIUM LASER WITH SPECIFIC RADIATION ENERGY OF $5\text{J}/1\cdot\text{atm}$

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 29 Dec 83) pp 1683-1685

BOKHAN, P. A. and YEGOROV, L. Ye., Thermal Physics Institute,  
USSR Academy of Sciences.

[Abstract] An helium-europium ion laser with a gas-discharge tube 50 cm long and 9.8 mm in diameter excited by a train of short pulses is investigated. The excitation pulses were generated in bursts 1-10 ms long, with individual pulse durations of 0.3-1  $\mu\text{s}$ . The excitation of the mixture was found to be uniform across the aperture up to  $1\text{ kJ}/1\cdot\text{atm}$ . Additional population of the upper working levels in Eu ions using the beam excitation method is investigated. Helium-europium ion lasers are found to be promising sources for powerful radiation in the near-IR, and perhaps visible, portions of the spectrum. Figures 2; references: 8 Russian.  
[70-6900]

RADIATION SPECTRUM OF YAG:Nd<sup>3+</sup> LASER WITH NONSTATIONARY CAVITY

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 24 Nov 83) pp 1674-1676

KAPRALOVA, O. N. and KAPTSOV, L. N., Moscow State University  
imeni V. M. Lomonosov.

[Abstract] Variations in the lasing spectrum caused by mode interaction through the inverse population of the active medium are one of the reasons for kinematic mode locking in YAG:Nd<sup>3+</sup> lasers. The effect of movements of the end mirror on the lasing spectrum are investigated theoretically and experimentally. A numerical experiment based on a system of truncated equations allowing for the spatial heterogeneity of population inversion of the working levels on the mode interaction is described. Spectral broadening is observed for mirror vibration rates ranging from 0.2 to 4 KHz. Calculations for seven longitudinal modes show that energy redistribution throughout the spectrum causes cutoff of the central mode and excitation of side modes. Figures 2; references 8: 7 Russian, 1 Western.  
[70-6900]

UDC 621.373.826.038.824

## CATHODE-LUMINESCENT PUMPED R6G LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 21 Oct 83) pp 1670-1671

LISITSYN, V. M., LYAKH, G. O., ORLOVSKIY, V. M., OSIPOV, V. V. and  
URBAZAYEV, M. N., High-Current Electronics Institute, Siberian  
Department, USSR Academy of Sciences.

[Abstract] The use of cathode luminescence excited by a short powerful electron beam for pumping organic dye lasers is investigated. R6G organic dye pumped by radiation from a commercially produced CdS-crystal cathode luminophor with a high quantum yield was employed. Measurements were made of the energy spectrum of the electrons in the beam, the radiation spectrum of the CdS, the absorption and radiation spectra, as well as the temporal characteristics of the pumping and lasing radiation. R6G lasing energy of 1 mJ with efficiency of 0.3% with respect to the electron beam energy was obtained. The results indicate that the use of cathode luminescence holds promise for exciting organic dye lasers. The method provides good agreement of the spectral and temporal characteristics of the cathode luminophor and active substance; it makes it possible to employ an active medium with a comparatively large volume, and allows the electron beam energy to be converted efficiently to cathode luminophor radiation. Figures 3; references: 5 Russian.  
[70-6900]

## REDUCTION OF THRESHOLD CURRENT OF InGaAsP/InP HETEROLASERS SUBJECTED TO UNILATERAL COMPRESSION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 14 Oct 83) pp 1665-1667

YELISEYEV, P. G., SVERDLOV, B. N. and SHOKHUDZHAYEV, N., Physics  
Institute imeni P. N. Lebedev, USSR Academy of Sciences.

[Abstract] Threshold, polarization and temperature investigations of injection lasers are performed in the 1.06-1.60  $\mu\text{m}$  region in order to clarify the role of uniaxial deformation in InGaAsP/InP heterolasers. The influence of unilateral compression in the direction of the normal to the active plane is studied, showing that for TM-polarization modes the threshold current drops (by 10-30%) as the uniaxial pressure increases; the differential efficiency increases, as does the parameter  $T_0$  of the temperature function of the threshold current. The point  $T_b$  corresponding to a discontinuity in that function becomes smaller. Three types of specimens are singled out: those which switch from TE- to TM- polarization caused by pressure, those operating with TE- polarization, and those operating with TM- polarization within the range of pressures indicated (below 2.5 kbar). Since unidimensional compression along the axis normal to the plane of the heterojunction is equivalent to mismatching of the lattices (in that plane), the TM or TE modes can be set to the desired level by introducing the required non-isoperiodicity in the heterostructure. Figures 2; references 8: 4 Russian, 4 Western.

[70-6900]

## INTENSE COMPRESSION OF DYE-LASER PULSES EMPLOYING PICOSECOND SINGLE-PULSE EXCITATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 17 Oct 83) pp 1668-1669

PETNIKOVA, V. M., PLESHANOV, S. A. and SHUVALOV, V. V., Moscow State  
University imeni M. V. Lomonosov.

[Abstract] A mechanism is described for the formation of the temporal structure of a superluminescence pulse in a dye laser in order to obtain spectrally-limited picosecond pulses. The experiments were conducted using a cuvette pumped by second-harmonic radiation from a passive mode-locked YAG picosecond laser. Intense compression of the laser pulses is demonstrated. The type and width of the outer correlation function are found to depend upon the amount by which the pumping exceeds the threshold; the auto correlation function becomes discontinuous as the excitation energy



increases, indicating the production of several picosecond pulses for each pumping pulse. The mechanism described also holds for distributed-feedback lasers and lasers with super-thin cavities. The devices proposed are reliable and provide stable parameters, with a widely controllable lasing spectrum. Figures 2; references 8: 4 Russian, 4 Western.  
[70-6900]

UDC 621.378.324

#### INVESTIGATION OF TUNABLE CO<sub>2</sub> LASER EXCITED BY TRANSVERSE HIGH-FREQUENCY DISCHARGE

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 5 Nov 83) pp 1651-1653

RYABYKH, V. N., SVICH, V. A. and TOPKOV, A. N., Khar'kov State University imeni M. Gor'kiy.

[Abstract] A CO<sub>2</sub> laser employing transverse capacitive HF excitation with a glass discharge chamber 19 mm in diameter is investigated. The active region of the discharge was 1 meter long, in a cavity 1.3 meters long. The laser was excited by an HF oscillator operating in the 13.56 MHz band. The gain was measured for certain vibrational transitions of carbon dioxide gas. Output power of 45W was obtained, with gain of the active medium of 0.9 m<sup>-1</sup>. The output power per unit length of discharge is as good as that of dc lasers, and the efficiency and gain are better, Figures 3; references 10: 6 Russian, 4 Western.  
[70-6900]

UDC 621.373.826.038.832

#### ENERGY CHARACTERISTICS OF WAVEGUIDE CO<sub>2</sub>-LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 3 Jan 84) pp 1641-1645

KONEV, Yu. B., LIPATOV, N. I., PASHININ, P. P. and PROKHOROV, A. M., General Physics Institute, USSR Academy of Sciences.

[Abstract] This study describes the numerical modeling of a waveguide CO<sub>2</sub>-laser in the linear amplification and lasing modes by the balance equation method for average numbers of individual mode quanta. The composition of the working medium is assumed to be constant, and allowance is made for quantum flow to levels above the minimum of the Triner distribution function of the assymmetrical CO<sub>2</sub>-molecule mode caused by the high degree of vibrational excitation of the medium. The approach employed takes into account the effect of surface deactivation of CO<sub>2</sub> molecules on the inner walls of the

waveguide. Calculations are made for discharge-channel diameters of 1.5 and 2.0 mm. Discharge current values are plotted as a function of the lasing output power and the electromagnetic field intensity in the cavity. It is found that surface deactivation of the excited mixture can cause substantial losses of vibrational  $V_3$ -mode energy of  $CO_2$  and  $N_2$ , particularly when the active medium pressures are comparatively low. Figures 4; references 11: 9 Russian, 2 Western.  
[70-6900]

UDC 621.378.325:533.9.03

# ENERGY TRANSPORT BY $\alpha$ -PARTICLES IN LASER PLASMA CONTAINED IN MAGNETIC FIELD

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 22 Nov 83) pp 1575-1581

GUS'KOV, S. Yu., ROZANOV, V. B. and TREBULEVA, L. Ye., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences.

[Abstract] Energy transport by  $\alpha$ -particles in a laser beam in the presence of a constant magnetic field is investigated theoretically by using general methods for solving the kinetic equation describing  $\alpha$ -particle movement in a magnetic field. The primary emphasis is on increasing the energy transferred to the plasma by the  $\alpha$ -particles (which is necessary for the development of efficient thermonuclear combustion of a laser target). General and partial analytical solutions are constructed for the kinetic equation. It is shown that the compression of laser targets in a magnetic field with intensity of several tens of kilogauss results in a significant increase in the energy transmitted by  $\alpha$ -particles to the plasma. The general solution of the kinetic equation based on the method of characteristics can be used for numerical modeling of the energy transfer by thermonuclear  $\alpha$ -particles in a laser plasma in a uniform magnetic field (e.g., by the Monte Carlo method). Figures 4; references 11: 9 Russian, 2 Western.  
[70-6900]

# CHROMIUM- AND NEODYMIUM-ACTIVATED GADOLINIUM-SCANDIUM-GALLIUM GARNET CRYSTAL: A NEW LASER ACTIVE MEDIUM

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 2 Aug 83) pp 1565-1574

ZHARIKOV, Ye. V., LAPTEV, V. V., OSTROUMOV, V. G., PRIVOS, Yu. S.,  
SMIRNOV, V. A. and SHCHERBAKOV, I. A., General Physics Institute,  
USSR Academy of Sciences.

[Abstract] The mechanisms underlying the population of the upper lasing level of neodymium is investigated in order to identify the optimum working conditions for the active medium in various types of lasers. A general method is proposed for calculating the population of the excited state of acceptors interacting with energy donors which allows for non-radiative losses in the acceptor subsystem for the steady-state and pulsed pumping modes for any pumping pulse form. The time evolution of the population of the upper lasing level of  ${}^4F_{3/2}Nd^{3+}$  in gadolinium-scandium-gallium garnet crystals activated with chromium and neodymium is analyzed, along with the population gain in the  ${}^4F_{3/2}$  level of  $Nd^{3+}$  due to sensitization of  $Nd^{3+}$  ion luminescence by  $Cr^{3+}$  ions. The proposed method for calculating the kinetics of the decay of the excited state of acceptors interacting with energy donors is used to find the optimum concentrations of  $Nd^{3+}$  ions in chromium- and neodymium- activated gadolinium-scandium-gallium garnet crystals for steady-state and impulse modes. Figures 4; references 17: 13 Russian, 4 Western. [70-6900]

# TWO-FREQUENCY PASSIVE MODE LOCKING IN IODINE PHOTODISSOCIATION LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 14 Feb 84 after revision) pp 1542-1554

KISELEV, V. M., GRENISHIN, A. S., KOTLIKOVA, T. N. and RODINA, L. I.

[Abstract] The characteristics of two-frequency lasing in the mode-locking condition in an iodine laser are investigated, and the passive mode locking condition is analyzed. Partially-summed Maxwell-Bloch equations are used to estimate the ultimate capabilities of passive mode locking. A system of equations describing the formation of a single pulse from the original noise distribution is derived and solved numerically for two-frequency and single-frequency lasing modes. The experimental findings indicate that a magnetic field is a convenient flexible tool for influencing the lasing characteristics of a passive mode-locked iodine laser in order to obtain the required parameters of the output radiation. Combination frequencies  $\nu_{22}-\Delta\nu$  and

$\nu_{34} + \Delta\nu$ , where  $\Delta\nu$  is the spectral interval between  $\nu_{22}$  and  $\nu_{34}$ , are found experimentally and explained. Figures 6; references 18: 14 Russian, 4 Western.  
[70-6900]

UDC 621.375.826

#### LONG-WAVE MOLECULAR LASERS AND PROSPECTS FOR DEVELOPMENT (A REVIEW)

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 28 Sep 83) pp 1515-1532

MOLEVICH, N. Ye. and ORAYEVSKIY, A. N., Physics Institute  
imeni P. N. Lebedev, USSR Academy of Sciences.

[Abstract] This study outlines the basic types of molecular lasers operating at wavelengths exceeding 15  $\mu\text{m}$  and employing electric-discharge, optical and chemical excitation. The history of the development of these types of pumping, and basic findings for each, are presented. Optical pumping is found to be more effective than electric discharge. Other methods for pumping long-wave lasers based on the VRT-relaxation mechanism are discussed. References 174: 37 Russian, 137 Western.  
[70-6900]

UDC 621.378.4

#### EFFICIENT GENERATION OF SECOND HARMONIC OF TUNABLE $\text{CO}_2$ LASER IN $\text{ZnGeP}_2$

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 18 Apr 84) pp 1511-1512

ANDREYEV, Yu. M., VOYEVODIN, V. G., GRIBENYUKOV, A. I., ZYRYANOV, O. Ya., IPPOLITOV, I. I., MOROZOV, A. N., SOSNIN, A. V. and KHMEL'NITSKIY, G. S., Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences; Siberian Physical-Technical Institute.

[Abstract] Second-harmonic generation in single crystals of  $\text{ZnGeP}_2$  is demonstrated for a  $\text{CO}_2$  laser tunable in the 9.19-9.7 and 10.15-10.8  $\mu\text{m}$  bands. The second-harmonic conversion coefficient is found as a function of the pumping wavelength and the crystal temperature. The rate at which the phase matching angle decreases during heating is investigated, and the spectral, angular and temperature matching widths are investigated. More efficient conversion is obtained in the  $\text{ZnGeP}_2$  crystals than has been achieved elsewhere in  $\text{CdGeAs}_2$  crystals. The ease of manufacture and superior operating properties of  $\text{ZnGeP}_2$  crystals makes them promising for doubling in the 9.2-10.8  $\mu\text{m}$  band. Figures 2; references 5: 1 Russian, 4 Western.  
[70-6900]

## INJECTION HETEROLASERS WITH ENHANCED RADIATION CHARACTERISTICS

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 4 May 83 after revision) pp 2196-2200

ADLIVANKIN, A. S., ALAVERDYAN, S. A., ZHUKOV, N. D. and POPOV, A. I.

[Abstract] This study describes the investigation of three types of gallium-aluminum-arsenic heterolasers with enhanced, stable lasing characteristics. The structure, threshold current distribution yields and lasing spectra of zig-zag mesastructure, buried-convex and multistripe lasers are analyzed and compared. Multistripe heterolasers are found to provide single-mode, single-frequency radiation, along with linear output characteristics and enhanced power. Figures 4; references 10: 6 Russian, 4 Western.  
[151-6900]

## STABILITY OF TRANSVERSE PARTICLE MOTION IN ACCELERATOR EMPLOYING MAGNETIC QUADRUPOLE FOCUSING

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 21 Feb 84 after revision) pp 2258-2261

KHIZHNYAK, N. A., KHORUZHIIY, V. M. and SHULIKA, N. G., Khar'kov  
Physical-Technical Institute, Ukrainian SSR Academy of Sciences.

[Abstract] Analytical expressions are derived for the phase creep and minimum instantaneous frequency of transverse oscillations in an accelerating-focusing channel. The expressions are derived on the basis of a continuous approximation, assuming the particle energy to be fixed in the focusing period. The expressions derived make it possible to determine the characteristics of an accelerating-focusing channel through the focusing and defocusing parameters without constructing stability diagrams.  
References: 5 Russian.  
[151-6900]

## TRANSVERSE INSTABILITY OF HIGH-CURRENT BEAM IN MULTISECTION PROTON ACCELERATOR

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 25 Jul 83) pp 2266-2268

KRAVCHUK, L. V., OSTROUMOV, P. N., PARAMONOV, V. V. and FATEYEV, A. P.,  
Nuclear Research Institute, USSR Academy of Sciences.

[Abstract] Transverse beam instability in a multisection linear proton accelerator is investigated analytically and modelled numerically. The mechanism underlying the development of transverse instability is examined. Instability is analyzed assuming that the beam excites only an  $EH_{11}$  asymmetrical hybrid wave. The Lorentz force acting on the particles is assumed constant, and the field amplitude is proportional to the deflection of the electron bunch from the axis. It is found that the rate of development of beam instability is determined mainly by the length of the accelerating structure, the beam current and the shunt resistance of the parasitic oscillation mode. Figures 2; references 6: 5 Russian, 1 Western.  
[151-6900]

UDC 621.384.66:621.385.6

## GENERATION OF POWERFUL MICROWAVE RADIATION BY HIGH-CURRENT ELECTRON MINI-ACCELERATORS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 3, Nov 84  
(manuscript received 2 Apr 84) pp 624-626

YEL'CHANINOV, A. S., KOROVIN, S. D., MESYATS, G. A., corresponding member,  
USSR Academy of Sciences, SHPAK, V. G., YALANDIN, M. I., High-Current  
Electronics Institute, Siberian Department, USSR Academy of Sciences.

[Abstract] An experimental investigation is described of powerful millimeter-band microwave generators producing nanosecond pulses employing the electron beam of high-current miniaccelerators as injectors. A SINUS-M-3 pulse-periodic electron accelerator of the accelerator was charged through a Tesla pulse transformer. The generation of radiation in a backward-wave tube was investigated: radiation at  $\lambda = 8.5 \pm 0.5$  mm with peak power of 6 MW was obtained experimentally, corresponding to electron efficiency of 5 percent. The spectral composition of the radiation produced in the backward wave tube was investigated, and the shortwave portion of the spectrum recorded. The shortwave radiation power was analyzed as a function of the magnetic field. The use of miniaccelerators opens up a new direction in relativistic high frequency electronics, inasmuch as these devices make it possible to develop compact microwave oscillators that can be used far more widely than existing devices. Figures 3; references: 10 Russian.  
[162-6900]

## LIGHTGUIDE CAVITY RING GARNET LASER

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 17 Apr 84) pp 1509-1511

DIANOV, Ye. M., ZABELIN, A. M., ISAYEV, S. K. and KORNIYENKO, L. S.,  
Nuclear Physics Scientific Research Institute, Moscow State University  
imeni M. V. Lomonosov; General Physics Institute, USSR Academy of Sciences.

[Abstract] A continuous ring lightguide laser employing a YAG:Nd<sup>3+</sup> crystal as the active element is developed and investigated. The experiments employed a two-layer lightguide with a quartz core 30-40 mm in diameter, numerical aperture of 0.17 and losses of less than 10 dB/km at  $\lambda = 1.06 \mu\text{m}$ . Coupling between the counter-propagating waves was reduced by coating the ends of the lightguide, the active element and the surface of the matching lenses. When a round homogeneous fiber was used, axisymmetrical lasing similar to the TEM<sub>00</sub> mode was observed. These lasing modes were noted experimentally: 1) counter-propagating wave synchronization; 2) antiphase self-modulation of counter-propagating waves at frequencies below 20 KHz; 3) a bistable condition in which the lasing direction switched with frequencies of several kilohertz. The findings indicate that the deformation of fiber optic lightguides in ring lasers makes it possible to control lasing modes effectively, thus expanding functional capabilities for instrumentation applications. Figures 2; references 6: 5 Russian, 1 Western.  
[70-6900]

UDC 621.375

## ELECTRON DISTRIBUTION FUNCTION IN OPTICAL LASER RADIATION FIELD IN MOLECULAR GAS

Moscow FIZIKA PLAZMY in Russian Vol 10, No 5, Sep-Oct 84  
(manuscript received 4 Aug 83 after revision) pp 1014-1020

KONOVALOV, V. P. and SON, E. Ye., Moscow Physical-Technical Institute.

[Abstract] The electron energy distribution functions are calculated in nitrogen, oxygen and air in a strong laser radiation field by integrating the kinetic equation numerically with detailed allowance for elementary interaction processes between electrons and molecules. A quantum kinetic equation for the electron energy distribution function is derived on the assumption that step ionization, shocks of the second kind, and electron-electron and electron-ion collisions can be disregarded. The power absorbed by electrons, the average electron energy, the electron energy loss distribution on nonelastic molecular excitation and the breakdown of nitrogen by first-harmonic radiation from a neodymium laser are analyzed. The breakdown

intensity in nitrogen is found to be a nonmonotonic function of the quantum radiation value. Figures 5; references 20: 7 Russian, 13 Western.  
[120-6900]

UDC 535.21:621.378

#### LOW-THRESHOLD OPTICAL BREAKDOWN IN POLARIZED RADIATION

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 5 Jan 84) pp 2184-2189

BONCH-BRUYEBICH, A. M. and SMIRNOV, V. N.

[Abstract] The relationship between the breakdown threshold of a solidstate target and the angle of incidence of polarized radiation from a CO<sub>2</sub> laser is investigated. The difference between the surface damage thresholds and plasma formation thresholds is studied for optical materials with significantly differing optical properties when exposed to variously polarized laser radiation pulses. It is found that the breakdown of transparent dielectrics is initiated by the heating of absorbing inhomogeneities embedded in the surface layer of the specimen. The results indicate that the serviceability of optical elements employed with angles of incidence exceeding 45° can be increased significantly by using radiation polarized in the plane of incidence without disturbing the operation conditions of the optical circuit. Figures 2; references 10: 5 Russian, 5 Western.  
[151-6900]

UDC 555.34:621.378

#### INFLUENCE OF INDUCED ABSORPTION IN REFLECTION MATERIAL ON EFFICIENCY OF SOLID STATE LASERS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 8, Aug 84  
(manuscript received 26 Dec 83) pp 1681-1683

NASEL'SKIY, S. P., NOVIKOV, V. K., RYABOV, A. I., SERGEYEV, A. M. and TOROPKIN, G. N.

[Abstract] The occurrence of induced absorption in a quartz glass reflector caused by the ultraviolet portion of the pumping radiation or external ionizing radiation is assessed quantitatively through experimentation and through a Monte Carlo computer simulation. The investigations were performed on a monoblock quartz-glass reflector consisting of a round cylinder with a silver reflecting coating on the outer surface. The experimental and analytical variations in laser efficiency agree well, indicating that the analytical approach can be used for lasers employing monoblock reflectors of other designs as well. Figures 1; references 10: 6 Russian, 4 Western.  
[70-6900]



COHERENT ANTI-STOKES LIGHT SCATTERING DIAGNOSIS OF CAPILLARY DISCHARGE OF  
CO<sub>2</sub> WAVEGUIDE LASER

Leningrad PIS'MA V ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 11, No 1,  
12 Jan 85 (manuscript received 5 Sep 84) pp 3-7

VAKHTEROV, A. A., ILYUKHIN, A. A., KONEV, Yu. B., LIPATOV, N. I.,  
PASHININ, P. P., PROKHOROV, A. M., SMIRNOV, V. V. and YUROV, V. Yu.,  
General Physics Institute, USSR Academy of Sciences

[Abstract] The coherent anti-Stokes light scattering method is employed to diagnose a capillary discharge in a typical CO<sub>2</sub>:N<sub>2</sub>:He=1:1:8 working mixture in a CO<sub>2</sub> waveguide laser with a cylindrical waveguide 3 mm in diameter made of BeO ceramic. The translational temperature is investigated as a function of the radius of the capillary discharge, with good agreement between the experimental and theoretical findings. The relationship between the vibrational temperature of nitrogen and the radius of the capillary discharge is investigated. The findings indicate that the diagnostic method is useful for studying the pumping power distribution by degrees of freedom of the components of the discharge. Figures 2; references 8: 7 Russian, 1 Western.  
[271-6900]

UDC 621.373:535

EFFECT OF SPONTANEOUS EMISSION AT THE WORKING TRANSITION ON NOISE IN A RING  
LASER

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 2, Feb 85  
(manuscript received 5 Apr 83) pp 452-454

ZMIYEVSKOY, G. N.

[Abstract] A semiclassical analysis showed that the spontaneous emission at the working wavelength in a ring laser operating on the 3s<sub>2</sub>-3p<sub>4</sub> transition in Ne at  $\lambda = 3.39 \mu\text{m}$  can have a substantial effect on the noise in such a laser. It was shown that because the counter-propagating waves are coupled to one another, the counter-propagating spontaneous radiation is regenerated in the resonator. It was found that in the single-wave lasing zone the importance of spontaneous emission increases with the pump current and the fluctuations in the amplitude of the laser field depend weakly on the laser frequency. Both the regeneration effect and the weak frequency-dependence of the amplitude fluctuations were observed experimentally. Figures 1; references: 6 Russian.  
[317-9368]

# EFFECT OF PERTURBATIONS OF THE DISCHARGE CURRENT ON THE BEAT FREQUENCY OF CIRCULARLY POLARIZED COUNTER-PROPAGATING WAVES IN A ZEEMAN RING LASER WITH REVERSIBLE FREQUENCY BASE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 2, Feb 85  
(manuscript received 31 May 83) pp 285-292

CHETVERIKOV, V. I.

[Abstract] A Zeeman ring laser (ZRL) in a state far above threshold was studied theoretically and experimentally to explain the contribution of modulations of the discharge current to the reversible component of the deviation of the beat frequency. The contribution of different perturbation mechanisms were studied: perturbations of the population inversion, modulations of the intensity of the traveling wave, modulation of the losses, nonlinearities of the index of refraction, and dynamic effects arising from the displacement of gas. A non-linear polynomial expansion for  $\delta F$  with experimentally-determined coefficients based on these mechanisms is presented. As an example, for the case of a resonator whose bandwidth  $\sim 1.16$  MHz was measured directly, an analysis of experiental data gave the result  $\sim 1.2 \pm 0.3$  MHz. Figures 4; references 26: 24 Russian, 2 Western. [317-9638]

UDC 533.36:621.328

## STIMULATED RAMAN SCATTERING WITHIN CAVITY OF MONOPULSE RUBY LASER

Minsk VESTSI AKADEMII NAVUK BSSR SERYYA FIZIKA-MATEMATYCHNYKH NAVUK  
in Russian No 1, Jan-Feb 85 (manuscript received 23 May 83) pp 69-74

ORLOVICH, V. A., Physics Institute, Belorussian SSR Academy of Sciences.

[Abstract] A quantitative experimental investigation of stimulated Raman scattering in benzine contained in the cavity of a monopulse ruby laser is described. The influence of stimulated Raman scattering on the laser is examined, and the factors causing divergence between the theoretical and experimental findings are analyzed. It is found that nonlinear light scattering effects have a strong influence on the laser and stimulated Raman scattering generation for long benzine cells. Figures 2; references 15: 13 Russian, 2 Western. [299-6900]

## WAVEGUIDE CO-LASER FOR MONITORING ATMOSPHERIC POLLUTION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 8 Sep 83) pp 44-47

KORNILOV, S. T., PROTSENKO, Ye. D. and TYMPER, S. I.

[Abstract] A simple, compact CO laser that is switched electrically between adjacent vibrational-rotational transitions is described. A switched two-frequency mode is obtained experimentally in a waveguide CO laser in which the cavity consists of a beryllium oxide waveguide, a diffraction grating and a flat mirror secured to a piezoceramic piece. The use of two-frequency differential absorption to monitor atmospheric pollution is described. An imbalance of up to  $4 \cdot 10^{-4}$  can be detected by virtue of the absorption of the laser emission by the pollutant. This level of sensitivity makes it possible to detect nitric oxide in concentrations of approximately 0.4 ppm over paths 10 m long. Figures 3; references 7: 2 Russian, 5 Western.

[244-6900]

## CALCULATION OF EMITTED PULSE LENGTH OF SOLID-STATE Q-MODULATED LASER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 2, Feb 85  
(manuscript received 15 Jun 83) pp 406-407

MINAYEV, V. P., PLOTNIKOV, V. M. and TURKOV, Yu. G.

[Abstract] Simple formulas are derived for the emitted pulse length of a Q-modulated solid-state laser that are convenient for engineering calculations. The usual expression for pulse length, defined as the ratio of the output energy to the peak radiated power, is modified to relate the pulse length with the parameters measured experimentally. The formulas derived can also be used directly for periodic lasers, in which case the pulse length is expressed through the average radiated power and the pulse repetition frequency. The expression for  $\Delta t$  derived is investigated experimentally on a CW YAG:Nd periodic Q-modulated laser. The experimental data agree well with the figures predicted by the formula. Figures 2; references: 3 Russian.

[279-6900]

A METHOD FOR STABILIZING EMITTED POWER OF HF-PUMPED CO<sub>2</sub> LASER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 30, No 2, Feb 85  
(manuscript received 4 May 83) pp 408-409

MIRZAYEV, A. T., STEPANOV, V. A., SIPAYLOV, A. A., SHARAKHIMOV, M. Hz.,  
and SHAYAKHOV, R. F.

[Abstract] A system is described for stabilizing the power of an HF-pumped CO<sub>2</sub> laser with two regulation loops, variation of the level of the HF power absorbed by the gas discharge plasma and changing of the cavity length by means of a piezo element. The system employs automatic discrete regulation of the output power in conjunction with the classical principle of analog signal control. The first loop compensates for slow drifting of the power by changing the pumping power; the second loop provides preliminary discrete stabilization by changing the cavity length. A recording of the output power with and without automatic stabilization shows that fluctuations of 1-10% without automatic stabilization are reduced to 0.3% over one hour of continuous operation by activating the stabilization system. Figures 2; references: 4 Russian.  
[279-6900]

PULSED SEPARATELY-LIMITED InGaAsP/GaAs DUAL HETEROSTRUCTURE LIQUID-EPITAXY LASER PRODUCING 77 mW ( $T = 300$  K,  $\lambda = 0.87$   $\mu$ m)

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 19, No 1,  
Jan 85 (manuscript received 29 Jun 84) pp 136-138

GARBUZOV, D. Z., ARSENT'EV, I. N., VAVILOVA, L. S., TIKUNOV, A. V. and  
TULASHVILI, E. V., Physical-Technical Institute imeni A. F. Ioffe,  
USSR Academy of Sciences.

[Abstract] Broad lasers with varying cavity length based on the title dual heterostructure InGaAsP/GaAs laser described in an earlier study by the authors are investigated. The absolute and nominal threshold current densities are compared for 32 laser diodes made by narrowing the GaAs[111] substrate to 100  $\mu$ m and applying solid ohmic contacts. The findings indicate that broad InGaAsP/GaAs dual heterostructure lasers can serve as the source of pulse and continuous radiation in a number of practical applications. The main advantage of these lasers is the simplicity of the technologies for growing the structures and fabricating the laser diodes. One disadvantage of these devices is the irregular distribution of the near-field radiation. Figures 2; references: 3 Russian.  
[284-6900]

ELECTROIONIZATION EXCITATION OF  $H_2(D_2):He(Ar)$  MIXTURES

Moscow KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK in Russian, 1984, No 10  
(signed to press 2 Oct 84) (manuscript received 14 Jun 84) pp 53-57

BASOV, N. G., ZVORYKIN, V. D., IONIN, P. P., KIPSHAKBAYEV, A. I., KOVSH, I. B.,  
LESNOV, I. A., LYTKIN, A. P., PANTELEYEV, V. I. and SOBOLEV, V. A.

[Abstract] The energy characteristics of an electroionization discharge in  $H_2(D_2)$  and  $H_2(D_2):He(Ar)$  mixtures were investigated on three different systems producing measurement error not exceeding 15%. It was found that a stable bulk energy contribution can be obtained at less than approximately 100 J/l·Amagat for  $T < 100$  K by electroionization excitation of mixtures of  $H_2$  and  $D_2$  with Ar and He. 50-60% vibrational excitation efficiency was found for  $H_2(D_2):He$ , and 70-80% for  $H_2(D_2):Ar$ . Inversion on vibrational-rotational transitions of the fundamental electron state of the  $H_2(D_2,HD)$  molecule can apparently be obtained by using comparatively weak excitation of very cold helium mixtures. Figures 2; references: 6 Russian.  
[296-6900]

UDC 621.378.325:535.8

## COLOR-CENTER PASSIVE-SHUTTER LASER FOR DYE PUMPING

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 2, Feb 85  
(manuscript received 18 Oct 83) pp 325-327

KORDA, I. M. and RUBINOV, A. N.

[Abstract] The operating modes of a phosphate neodymium glass laser employing  $LiF$  crystals with  $F_2^-$  color centers with small initial transmission as the Q-modulators are investigated. The investigations show that the use of color-center Q-modulators in standard lasers makes it possible to obtain sufficient energy for practical purposes (over 1.0 J in a single pulse, or 4-5 J in a pulse train) using standard active elements. Figures 1; references: 8 Russian.  
[301-6900]

## NEODYMIUM-GLASS LASER PRODUCING VARIABLE-LENGTH U-SHAPED PULSE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 2, Feb 85  
(manuscript received 29 Oct 82) pp 334-336

GONCHAROV, V. K. and ZHUK, D. V.

[Abstract] A master oscillator for a neodymium glass laser that produces a variable-length U-shaped pulse is investigated. Quasi-steady radiation is obtained by means of lenses. The schematic layout of the master oscillator is explained in detail. The radiation produced by the system (up to 5 kW peak power) can be used directly for quantitative investigations in laser spectroscopy, and can be amplified for use in laser plasma dynamics. Figures 2; references: 2 Russian.  
[301-6900]

## OPTIMIZATION OF OPTICAL DENSITY OF ACTIVE ELEMENTS SUBJECTED TO LONGITUDINAL LASER EXCITATION

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 2, Feb 85  
(manuscript received 18 Aug 83) pp 197-201

MIKHNOV, S. A. and RAKUSH, V. V.

[Abstract] An analytical expression is derived for the average absorption coefficient of radiation pumping in media with vibrational-broadened levels. An approximate expression is presented for selecting the optimum optical density of the active elements. The analytical results are compared with experimental measurements on  $\text{LiF:F}^{2-}$  lasers. The proposed analytical expressions yield a depressed estimate of the optimum optical density of the active element; the estimate becomes more accurate for higher pumping power densities. Figures 1; references: 8 Russian.  
[301-6900]

EFFECTIVE FREQUENCY CONVERSION UNDER NON-RESONANT CONDITIONS AT HYDROGEN WAVELENGTH  $L_\alpha$ 

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 55, No 2, Feb 85  
(manuscript received 18 May 84) pp 335-342

BATISHCHE, S. A., BURAKOV, V. S., GLADUSHCHAK, V. I., GURLENYA, V. I., MOSTOVNIKOV, V. A., MOSHKALEV, S. A., RAZDOBARIN, G. T., SEMENOV, V. V., TARASENKO, N. V. and SHREIDER, Ye. Ya., Physical-Technical Institute A. F. Ioffe, USSR Academy of Sciences.

[Abstract] The conditions under which maximum lasing power is obtained at hydrogen wavelength  $L_\alpha$  (121.6 nm) are examined. Radiation at wavelength  $L_\alpha$  is generated by means of four-photon nonlinear processes. The optimum conditions for third-harmonic generation in gases, and the influences of the Kerr effect on that process, are investigated. An experimental setup is described that is used to investigate the conditions for the effective conversion of dye laser radiation at wavelength  $L_\alpha$  in krypton-argon mixtures. The experimental findings agree with the theory of the influence of the Kerr effect on third-harmonic generation on the  $L_\alpha$  line in krypton-argon mixtures. Figures 6; references 22: 6 Russian, 16 Western.  
[300-6900]

## PULSE ELECTROIONIZATION LASERS WITH CRYOGENICALLY COOLED ACTIVE MEDIUM

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 55, No 2, Feb 85  
(manuscript received 7 Jun 84) pp 326-334

BASOV, N. G., BAKAYEV, V. G., IONIN, A. A., KOVSH, I. V., KUCHAYEV, A. V., LYTKIN, A. P., PAISOV, V. N., SINITSYN, D. V. and SOBOLEV, V. A., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences.

[Abstract] A pulse electroionization laser employing a cryogenically-cooled working gas mixture is described. The energy and spectral-temporal characteristics of the cooled laser are examined in detail. The possibility of increasing the specific output by increasing the density of the working gas mixture is studied. The possibility of varying the laser pulse duration in the free-lasing mode is examined. Cryogenically cooled lasers are found to be reliable, economical and comparatively simple devices for investigating lasing and amplification processes over a wide range of pulse durations at energy levels of up to several hundred joules per pulse. Figures 4; references 21: 18 Russian, 2 Western.  
[300-6900]

## POSSIBILITY OF EXPANDING RANGE OF GENERATED EXCIMER MOLECULE WAVELENGTHS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA A FIZIKOMATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI in Russian No 12, Dec 84 (manuscript received 22 Jan 84) pp 53-55

GORBAN', I. S., corresponding member, Ukrainian SSR Academy of Sciences, ZUBRILIN, N. G., KERIMOV, O. M., MILANICH, A. I. and CHERNOMORETS, Kiev State University imeni T. G. Shevchenko.

[Abstract] A new possibility is investigated for expanding the range of wavelengths that can be generated by existing excimer molecules. Lasing is obtained on the 1-7 transition of an XeCl molecule as V X (where 1 is the first vibrational level of the B-state, and 7 is the vibrational level of the X-state). 1-7 transition lasing required that the pressure of the active medium be reduced. It is found that isotope composition plays an important part in the relaxation of excimer molecules with respect to the vibrational and rotational levels of the V-state. Figures 1; references 11: 4 Russian, 7 Western.  
[219-6900]

## SOLUTION OF LORENZ SYSTEM OF EQUATIONS IN THE ASYMPTOTIC LIMIT OF LARGE RAYLEIGH NUMBERS. I. LORENZ SYSTEM IN THE SIMPLEST QUANTUM MODEL OF A LASER AND APPLICATION OF THE METHOD OF AVERAGING

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 62, No 2, Feb 85 (manuscript received 26 Jun 84) pp 272-290

POKROVSKIY, L. A., All-Union Scientific-Research Center for the Study of the Properties of Surfaces and Vacuums

[Abstract] Starting from the Liouville equation for the density matrix of a system consisting of N two-level atoms interacting with an electromagnetic field in a cavity, an equivalent nonmatrix Fokker-Planck equation (Gordon's equation) was derived in the following form:

$$\alpha \rho(x, t) / \partial t = -(\Lambda_I + \Lambda_D) \rho(x, t).$$

Here  $\rho(x, t)$  is a quasiprobability density in a five-dimensional phase space  $x = [z, z^*, \alpha, \alpha^*, \theta]$ , where  $z$  is the complex amplitude of the state of the field,  $\alpha$  is a complex variable describing the polarization of an atom,  $\theta$  is a real variable describing the degree of inversion in the system,  $\Lambda_I$  is a first-order differential flow operator, and  $\Lambda_D$  is a second-order differential diffusion operator. The Fokker-Planck equation was then transformed by scaling the variables  $z$  and  $\alpha$  in the form  $u = z/\sqrt{S}$ , where  $S = \nu_L \nu_H / 4g^2 \gg 1$ ,  $\nu_L$  and  $\nu_H$  are atomic relaxation constants and  $g$  is the



field-atom coupling constant and a system of characteristic equations for  $u$ ,  $v$ , and  $\theta$  was obtained. These equations form a Lorenz system. The laser trajectories were found from the well-known bifurcation properties of Lorenz system. The system was solved in zeroth-order perturbation theory for large Rayleigh number  $r = \theta/\Delta \gg 1$ , where  $\Delta = \kappa v_1/Ng^2$  and  $\kappa$  is the damping constant of the field. First-order solutions were obtained by applying Bogolyubov's averaging method. It was shown that for  $\kappa < \kappa_1$  there exists an attractor corresponding to steady-state lasing. For  $\kappa > \kappa_2$  there exists an attractor corresponding to stationary oscillations. Finally, for  $\kappa_1 < \kappa < \kappa_2$  two attractors exist, i.e., the system is bistable and can either lase steadily or oscillate. Figures 5; references 30: 19 Russian, 11 Western [312-9638]

UDC 621.375.826+537.525

#### OSCILLATIONS OF ARGON LASER PLASMA

Duchanbe DOKLADY AKADEMII NAUK TADZHIKSKOY SSR in Russian Vol 27, No 10, Oct 84 (manuscript received 27 Jun 83) pp 570-573

KARASEV, V. A. and SALIMOV, V. M., Physical-Technical Institute imeni S. U. Umarov, Tadjik SSR Academy of Sciences.

[Abstract] The plasma oscillations of an argon ion laser are investigated systematically with and without a longitudinal magnetic field present. The primary stress is on regular oscillations used to modulate the discharge current. The experiments employed an argon laser using a quartz discharge tube with an inside diameter of 2.1 mm and a working section 350 mm long. The behavior of the oscillations as a function of the discharge current is found to be resonant in nature. The influence of a longitudinal magnetic field on plasma oscillations is studied. Anode oscillation is found to cause modulation of the output radiation; the relationship between the amplitude of the oscillations and the discharge parameters and value of the longitudinal magnetic field is resonant. Figures 3; references 12: 7 Russian, 5 Western. [320-6900]

## NUCLEAR PHYSICS

### ACHIEVEMENTS OF THE HIGH ENERGY PHYSICS INSTITUTE

Leningrad LENINGRADSKOYE ZNAMYA in Russian No 64(19784), 17 Mar 85 p 4

[Article by S. Kulinich under the rubric "Toward the Secrets of the Universe": "Microscopes of the 'Industrial' Epoch".]

[Text] There is no other name for a field of science in which progress depends entirely on the power of accelerators (those "twentieth-century pyramids"), incredible accuracy and the effectiveness of the electronics of fully automated multi-purpose installations. At a factory it is always possible to walk up to and adjust something in the production line. You cannot do this during the course of a physics experiment--you have to shut off the accelerator. And the "eyes" of a physicist are those instruments which show what is going on the depths of the installation.

In Protvino, a suburb of Moscow, the results achieved at the High Energy Physics Institute (HEPI) include the discovery of antihelium and antitritium nuclei. Here they created a special installation for the "Antihelium" program. This installation comprised more than 50 high speed monitors and detectors and a system of electronics consisting of more than 500 circuits. This system records events which take place in a millionth of a second.

This installation analyzed millions of particles each second, checking for the presence of antihelium nuclei. Finally, after sifting through hundreds of billions of particles, the physicists found what they were looking for-- 5 atoms of antihelium!

In 1973 a series of experiments was performed which revealed antitritium nuclei. The success of the complex program was predetermined to a large extent by a new and original procedure developed jointly by scientists at HEPI and the Joint Institute for Nuclear Research (JINR) in Dubna. Thus began an epoch of huge experimental installations, which combine multi-channel counters, unique equipment computers.

The first impression of HEPI's main experiment hall is of an incredible conglomeration of metallic structures. The enclosed hall (150 meters long by 90 meters wide) is so crowded that it seems each structure is tightly

wedged in with the next one. Over this chaos are foot bridges built to the physicists' "houses." These look like large containers with doors which are stuffed with apparatus. Apparently all the comforts here--fans, air conditioning, plumbing--are intended for the apparatus.

Actually, to a large extent the experimental technology is arranged efficiency. The secondary particle channels from the accelerator are "coordinated" by arrangement. There are about 20 channels, and the particles in each one of them service 2-3 physical machines. Usually, on the order of 15 machines are prepared for each session.

Compared to modern installations, those at HEPI were quite modest in size. In 1968, a spherical structure almost 5 meters diameter was wedged in between two sections of an accelerator magnet. This was the new particle trap built in Dubna, which would explain why elemental particles which differed in mass, lifetime and other properties had identical charges, like that of an electron.

In 1931 the English physicist, Paul Dirac, reflecting on the nature of electricity, predicted the existence of a particle made up of not two poles, but a pole of a single charge. Otherwise electric current would not have a strictly stipulated direction. Dirac's hypothesis has attracted scientists for more than half a century, but no one can yet state that there is no monopolar particle in nature. Having achieved no positive results, Dubna's international team of physicists only showed that no monopole occurs at the accelerator energies achieved at Protvino.

Over the last 16 years research installations have increased significantly in size and weight. For example, in 1978 a relativistic ionizing streamer chamber was started on HEPI's beam. This selective-type installation, built in Dubna by physicists, designers and electronics engineers from JINR and the national science centers of Hungary, GDR, the Soviet Union and Czechoslovakia, took up a space of more than 200 square meters. There was no other instrument like it; it recorded programmed types of elemental particle interactions while ignoring others.

The "Hyperon" spectrometer complex, which Bulgarian, Polish, Soviet and Czech physicists use to continue research at HEPI, works on the same principle. That plant is even bigger in its own way. It consists of three spectrometer "shops" and is filled with electronics and unique equipment.

Now, a giant detector which is unlike anything at Protvino or Dubna is being assembled in a gallery of HEPI's experimental hall. It is specifically designated in HEPI's planning as an object of high importance.

Accelerators have enriched science with remarkable discoveries. Thanks to them even the mysterious neutrino particle, predicted in the early 30's, has been discovered and its mysteries unraveled. This "something small and neutral," with no electric charge or mass, is extremely difficult to detect. Originating in space, the neutrino pierces the entire Earth without interacting in any way.

Sixty-five billion of these particles fall on a square centimeter of the Earth's surface every second. We live in an unending torrent of neutrinos.

Relatively recently Soviet scientists picked up some data that indicated that the neutrino does in fact have mass. In late 1979 a project was established by Protvino and Dubna for joint research in the area of neutrino physics. The project was carried out at a "Neutrino detector" research installation and was conducted by associates of HEPI, JINR, and Hungarian and GDR scientific centers. Physicists from Bulgaria, Poland and several Soviet institutes will also participate in future studies.

So, does a neutrino have mass? If so, then are neutrinos stable? How many varieties exist? How intensely does each variety interact with matter? The "Neutrino detector" is supposed to answer these and many other questions.

The decays of such particles as pi- and k-mesons, hyperons, charged particles and others serve as sources for neutrinos in accelerators. In order to obtain a beam of neutrinos, a special neutrino channel (a complex engineering structure which will focus the necessary mesons coming out of the target by special optical systems) will be built at HEPI. After channeling, the mesons will decay in a 140-meter vacuum tube to which is attached a tall 60-meter-long stack composed of massive steel beams. This is a filter for phonon particles which are formed together with neutrinos during meson decay and are capable of penetrating significant thicknesses of dense matter. However, their presence in the detector is undesirable; therefore a steel filter was built which will swallow these particles, while the neutrino will pass through the filter without hindrance and enter the detector.

The detector looks rather extraordinary. Its basic units are hundreds of electronic devices, a 1500-ton magnet, and 40 original targets which include 400 special fluid counters. Each counter is more than 5 meters long and is filled with an organic compound. The bursts coming from the passage of products of neutrino interactions will be recorded by 800 photoelectron multipliers. Special detectors, called drift chambers, will follow the trajectories of the particles formed. The total length of just the target of the neutrino detector is over 40 meters.

On the basis of information about neutrino interaction, physicists hope to eliminate a number of problems, not only in the area of the microcosm, but also in astrophysics. If it turns out that the neutrino does have mass, even the slightest, then we can assert that the bulk of the mass of the Universe is contained not in stars or in dense material, but in neutrinos. We can draw conclusions about what awaits the Universe, and what forms its evolution will take.

The works of JINR physicists in conjunction with their colleagues from HEPI take up several pages in the biography of the tremendous, unique and aspiring science of the microcosm. It is quite possible that joint research on the neutrino (which will present its surprises to the physicists of Protvino and Dubna) will also add to this biography.

## THE RIDDLE OF THE "ULTRASOFT" RAYS

Moscow SOVETSKAYA ROSSIYA in Russian 16 Nov 84 p 2

[Article by L. Kim: Previously Unknown Regularity in the Absorption of Ultrasoft X-ray Radiation.]

[Text] Yesterday a scientific discovery in the field of atomic physics was registered in the USSR State Committee for Inventions and Discoveries. Scientists of the Leningrad State University imeni A. A. Zhdanov, Doctors of Physical Mathematical Sciences A. P. Lukirskiy and T. M. Zimkina, succeeded in discovering a previously unknown regularity in the absorption of x-ray radiation by multielectron atoms.

Ultrasoft x-ray radiation gave rise to the discovery. Professor T. M. Zimkina recounts:

"As is known, x-ray radiation covers a wide range of wavelengths. The short wavelengths were the most studied. For the first time in our country A. Lukirskiy has devised equipment to conduct research in this intermediate region of the spectrum. We began to work. Experiments were conducted with various gases and solid substances. In the course of these experiments it was ascertained that the commonly known x-ray absorption law is inapplicable to the area of ultrasoft x-ray radiation."

Under this law, the probability of absorption is maximal for quanta whose energy corresponded precisely to the energy of the electron bond, that is, the energy needed to separate an electron from its atom. Increasing the quantum energy monotonically decreases the probability of absorption. For quanta of ultrasoft x-ray radiation, the following is characteristic: the probability of absorption changes nonmonotonically.

The scientific significance of the discovery is that this detected regularity has stimulated the development of contemporary atomic theory. It marks the beginning of a new scientific direction--ultrasoft x-ray spectroscopy. The discovery has broad practical significance. For example, the discovery has been the basis for the creation of devices recording the intensity of x-ray radiation in space.

12794  
CSO: 1862/120

UDC 537.534

#### WINDOWS OF TRANSPARENCY DURING DUAL-BEAM PIERCE INSTABILITY

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 3 Apr 84 after revision) pp 2277-2279

MOSIYUK, A. N., Physics Institute, Ukrainian SSR Academy of Sciences.

[Abstract] Expansion of the stable region is investigated for the case in which two beams are moving in the same direction at different rates. It is found that the dual-beam system is unstable in the unbounded case, regardless of the difference in rates; however, if the beam velocities are approximately the same, bounding them by conducting walls with fixed potential suppresses the instability of the interpenetrating beams and results in the occurrence of stable intervals. References 6; 1 Russian, 5 Western. [151-6900]

UDC 537.533.7;539.124.17

#### MODELLING OF BRAKING OF UNCOMPENSATED ELECTRON BEAM IN THIN ABSORBERS

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКИЙ FIZIKI in Russian No 6(148), Nov-Dec 84 (manuscript received 30 Aug 83) pp 20-25

BOYKO, V. I., GORBACHEV, Ye. A. and YEVSTIGNEYEV, V. V., Tomsk.

[Abstract] This study investigates the transmission of uncompensated high-current (up to 50 kA) electron beams through thin targets. A quasi-steady state analytical model is employed that is based on an iterative method in which the self-consistent problem is broken down into a series of non-self-consistent problems, as well as a Monte Carlo method for calculating the beam particle trajectories in the substance with allowance for Coulomb scattering. The results, which agree qualitatively with the theoretical predictions, are of interest in connection with extracting the beam from accelerators through anode foil or drift chamber foil, as well as using foil in the capacity of construction elements for diagnostic equipment.

The authors indicate the possibility of the appearance of a potential barrier, of oscillation of the beam electrons near the anode foil and of diode current cutoff. Figures 5; references 14: 12 Russian, 2 Western. [264-6900]

UDC 539.129

#### THERMODYNAMIC POTENTIAL OF QUARK-ANTIQUARK PLASMA IN CONSTANT CHROMOMAGNETIC FIELD

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 28, No 1, Jan 85 (manuscript received 21 Dec 83) pp 33-38

AGAYEV, Sh. S., VSHIVTSEV, A. S., ZHUKOVSKIY, V. Ch. and SEMENOV, O. F., Moscow Radio Engineering, Electronics and Automation Institute; Moscow State University imeni M. V. Lomonosov

[Abstract] Light-neutral quark-antiquark plasma in a constant optical magnetic field is investigated for the case of massive fermi- or bose-quarks of the same flavor, and a gauge SU(2)-group. The method employed is based on Schwinger's technique of functional integration and representation of the proper time, in which the plasma, particle propagators and external field are assigned directly in Euclidean space. Expressions are obtained for the thermodynamic potential of a quark-antiquark plasma in a non-Abelian gauge field; the behavior of the potential is studied as a function of the intensity of the external field at high and low temperatures. It is found that the applicability of the low-temperature limit is highly problematic because of the need for taking the interaction with the gluon sector into account. References 14: 2 Russian, 12 Western. [262-6900]

UDC 537.521

#### CALCULATION OF ENERGY CHARACTERISTICS OF ACCELERATORS WITH AZIMUTHAL ELECTRON DRIFT

Moscow FIZIKA PLAZMY in Russian Vol 11, No 2, Feb 85 (manuscript received 7 Feb 84) pp 206-210

GRISHIN, S. D., MARAKHTANOV, M. K., PONKRATOV, A. B. and KHOKHLOV, Yu. A., Moscow Higher Technical School imeni N. E. Bauman.

[Abstract] Azimuthal electron drift accelerators are investigated theoretically and experimentally. A system of differential equations is solved analytically in order to find the basic parameters of the plasma stream in the output section of the accelerator channel, as well as the voltage-current characteristic of the low-voltage discharge. The ion current

density, average ion energy, mass utilization coefficient and exchange parameter are found. Formulas are derived that can be used to estimate the energy characteristics of low-voltage accelerators in modes that provide a high coefficient of mass utilization. Figures 3; references 5: 4 Russian, 1 Western.  
[298-6900]

UDC 539.173.7

#### HALF-LIFE OF CURIUM-245 WITH RESPECT TO SPONTANEOUS FISSION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 6, Feb 85  
(manuscript received 2 Aug 84) pp 1351-1352

DRUZHININ, A. A., POLYNOV, V. N., VESNOVSKIY, S. P., KOROCHKIN, A. M., LBOV, A. A. and NIKITIN, Ye. A.

[Abstract] A specimen of highly-enriched Curium-245 obtained by double enrichment of a mixture of curium isotopes on an electromagnetic separator is investigated. The isotopic composition of the specimen is found by  $\alpha$ - and mass-spectrometry. The spontaneous fission period of the specimen is found by measuring the ratio of the  $\alpha$ -decay rate to the spontaneous fission rate. The average half-life for two targets was found to be  $(1.4 \pm 0.2n) \cdot 10^{12}$  years. This finding agrees with the theoretical prediction based on the spontaneous fission of heavy elements. References 5: 3 Russian, 2 Western.  
[278-6900]

UDC 537.533.001

#### MANIFESTATION OF SLIPPING INSTABILITY IN PARTIALLY COMPENSATED RELATIVISTIC ELECTRON BEAMS

Moscow KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK in Russian 1984, No 10  
(signed to press 2 Oct 84) (manuscript received 22 May 84) pp 26-29

KARBUSHEV, N. I., RUKHADZE, A. A. and UDOVICHENKO, S. Yu., General Physics Institute, USSR Academy of Sciences.

[Abstract] The convective instability of electron beams in a finite external longitudinal magnetic field (known as slipping instability) is investigated for a relativistic electron beam whose bulk charge is partially compensated by positive ions with  $f = n_1/n_e \leq 1$ , where  $n_e$  and  $n_1$  are the densities of the electron beam and background ions, respectively.<sup>1</sup> An exact solution is found for the case of a circular waveguide in which velocity irregularity is caused by a dip in the electrostatic potential. References: 4 Russian.  
[296-6900]



## RECORDING PROTON BEAM CHARACTERISTICS IN CYCLOTRON DURING REPEATED PASSES THROUGH TARGET

Moscow KRATKIYE SOOBSHCHENIYA PO FIZIKE: SBORNIK in Russian 1984, No 10  
(signed to press 2 Oct 84) (manuscript received 16 May 84) pp 18-22

BARIT, I. Ya., KATSAUROV, L. N., NECHAYEVA, L. P. and KHOKHLOV, Yu. K.,  
Nuclear Research Institute, USSR Academy of Sciences.

[Abstract] A method is investigated for measuring the current of a beam intersecting a target and the energy spread of the particles in the beam. The study was performed on an external-injection sectional 600 KeV cyclotron with the target located between the sections in one of the final orbits. The radial position of the revolutions of the beam was measured by a differential probe connected to an oscilloscope through a system of amplifiers and filters. The target served as the signal electrode used to register the beam during each pass, as well as the relative beam intensity during each revolution. The energy spectra of the protons scattered on the  $Al_2O_3$  target were compared for single and repeated passes. The current was found to increase by a factor of 6 for repeated passes as compared with single passes, and the width of the energy spectrum at half-height was found to increase from 19 KeV to 34 KeV. Figures 3; references: 3 Russian.  
[296-6900]

UDC 534.26:535.312

DIFFRACTION THEORY OF DISPLACEMENT OF BOUNDED WAVE BEAMS DURING REFLECTION. I.

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 2 Dec 83) pp 2094-2104

GODIN, O. A., Oceanology Institute imeni P..P. Shirshov, USSR Academy of Sciences.

[Abstract] The displacement of bounded monochromatic wave beams in the plane of incidence during total reflection from a flat interface between homogeneous media, often called the Goos-Hanchen effect, is investigated. Conditions for the applicability of the classical theory of displacement of directional wave beams reflected from a flat interface are analyzed. The analysis employs methods used earlier to investigate the wave field of a point source. The study consists of two sections, the first part of which examines the incidence of the beam at near the critical angle of total reflection and analyzes the influence of the form of the incident beam and the definition employed for the displacement on the amount of displacement. The second part analyzes grazing incidence of the beam and reflection from a 'weak' interface boundary. The displacement during reflection is investigated as a function of the shape of the envelope and the characteristics of the beam, as well as the influence of beam diffraction in free space and wave energy dissipation in the medium on the amount of displacement. Figures 5; references 26: 8 Russian, 18 Western.  
[151-6900]

## SCATTERING OF TERAHERTZ PHONONS ON YTTRIUM-ALUMINUM GARNET CRYSTALS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 27, No 1, Jan 85  
(manuscript received 3 Jul 84 after revision) pp 18-23

ABRAMOV, A. P., ABRAMOVA, I. N., GERLOVIN, I. Ya., RAZUMOVA, I. K.

[Abstract] The scattering processes and terahertz phonon propagation modes they determine in chromium-activated YAG garnet crystals are investigated. Superlinear luminescence of the  $R_2$  lines of  $Cr^{3+}$  ions in  $Y_3Al_5O_{12}$  crystals is observed experimentally at 2K. The excitation of luminescence is found to result from multiple reabsorption (trapping) of phonons that are resonant with respect to transition between the components of the chromium ion  $^2E$  state. It is found that significantly different propagation modes may be realized for nonequilibrium phonons. The probabilities of different phonon scattering mechanisms are assessed, and criteria are defined for the possibility of the establishment of local thermal equilibrium in garnet for different excitation modes of the excess phonons. As in ruby, the trapping efficiency of phonons in garnet is a linear function of the concentration of the excited centers, rather than quadratic as in the case of diffusion. Figures 4; references 12: 7 Russian, 5 Western.  
[280-6900]

VIBRATIONAL SPECTRA AND STRUCTURE OF NaF-GeO<sub>2</sub> GLASSES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 41, No 6, Dec 84  
(manuscript received 26 Jul 83) pp 944-950

MUKHITDINOVA, I. A., KABANOV, V. O., KIRIYENKO, I. A., PODOL'SKAYA, T. M.,  
POLUKHIN, V. N. and YANUSH, O. V.

[Abstract] The structure of NaF-GeO<sub>2</sub> glasses is investigated by vibrational (polarized Raman scattering) spectroscopy in order to determine the relationship between the optical properties of the glass and its composition. The changes occurring in the vibrational spectrum of the glass as a function of composition are interpreted by assuming that structural elements with fixed composition exhibiting a characteristic vibrational spectrum are formed in the glass. It is argued that the glass contains a discrete set of elementary structural elements consisting of GeO<sub>2</sub>, Na<sub>2</sub>.6GaO<sub>2</sub> and NaF.2GeO<sub>2</sub>, which determine its spectroscopic and physical-chemical properties. The data obtained on the composition of the structural elements can be used to interpret and analyze the physical-chemical properties of NaF-GeO<sub>2</sub> glasses. Figures 3; references 14: 8 Russian, 6 Western.  
[246-6900]

## ALGORITHM FOR REDUCTION TO IDEAL DEVICE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 22 Jun 83) pp 167-171

YAKOVLEV, A. A.

[Abstract] An algorithm for the reduction of experimental optical data is described for the case in which there is not enough a priori information to employ existing specialized reduction algorithms. The procedure described is an algorithm for solving inverse problems proposed elsewhere by the author that requires only information about measurement errors and some model of the sought function; the measurement result can be the model in the reduction problem. The use of the algorithm is demonstrated by solving a one-dimensional spectral reduction problem. The algorithm, which compares the measured spectrum with the response to the model and then corrects the spectrum in accordance with the difference between the response and the measurements, is shown to be highly effective and useful when the only a priori information about the sought solution is represented by a rough model. Figures 2; references 16: 7 Russian, 9 Western.  
[272-6900]

## EXPERIMENTAL INVESTIGATION OF RECORDING OF DYNAMIC HOLOGRAMS WITHIN ABSORPTION CONTOUR OF RESONANT ATOMIC MEDIUM

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 10 May 83) pp 147-152

KOROLEV, A. Ye. and STASEL'KO, D. I.

[Abstract] This study investigates the influence of the atomic concentration, the spectral width of the recording radiation and the resonance detuning on the diffraction efficiency of dynamic holograms recorded on the resonance lines of metals. The efficiency of resonant dynamic holograms is investigated as a function of the exposure for different vapor concentrations and resonance off-tuning. Good agreement is noted between the experimental and theoretical results. A region is identified in which the required tuning accuracy is determined by the spectral width of the recording radiation, which makes it possible to use a significantly wider group of radiation sources to record resonant dynamic holograms. Figures 4; references 18: 7 Russian, 11 Western.  
[272-6900]

## DIFFRACTION EFFICIENCY OF THREE-DIMENSIONAL PHASE HOLOGRAM OF DIFFUSE OBJECT

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 7 Jul 83) pp 142-146

KORZINTIN, Yu. L. and SUKHANOV, V. I.

[Abstract] The diffraction efficiency of the hologram of a diffuse object is analyzed within the framework of a space-frequency approach in which the diffraction efficiency is expressed through the spectrum of the wave recovered by the hologram. The diffraction efficiencies achieved and the exposures needed to achieve them are shown to be a function of the relationship between the intensities of the interfering beams, as well as the geometry of the hologram recording scheme. It is recommended that oblique incidence of the reference wave be employed in recording the hologram of the object. The angle of incidence of the object wave should take into account the fact that the hologram efficiency decreases as the angle becomes smaller, but that the exposure level needed to obtain maximum efficiency becomes somewhat longer. Figures 2; references: 9 Russian.  
[272-6900]

REGULAR REFLECTION (TRANSMISSION) OF RADIATION BY ROUGH SURFACES:  
UTILIZATION FOR MIRROR QUALITY CONTROL

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 29 Apr 83) pp 130-134

SAKHNOVSKIY, M. Yu.

[Abstract] This study demonstrates the possibility of solving the problem of mirror reflection from rough surfaces on the basis of a model of a two-dimensional sinusoidal statistical phase transparency. Mirror reflection from a surface formed by metal spheres placed on a plane is compared with mirror reflection from a two-dimensional sinusoidal transparency. The findings agree with existing experimental data on mirror reflection from different classes of rough surfaces, and can be used to control grinding and polishing processes, to assess mirror quality, to determine the parameters of IR mirrors used to filter off the short-wave region of the spectrum, and to study the optical parameters of rough surfaces and the interface between semiconductors and dielectrics. Figures 2; references 8: 6 Russian, 2 Western.  
[272-6900]

## SPLITTING OF COMPLETELY REFLECTED INCIDENT BEAM INTO TWO ELLIPTICALLY POLARIZED BEAMS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 19 Jul 83) pp 125-129

PUN'KO, N. N. and FILLIPOV, V. V.

[Abstract] The results of direct experimental investigations of a reflected beam are presented. Complete reflection of an electromagnetic wave incident from a medium with one index of refraction on the boundary with a second medium with a smaller index of refraction is examined. It is demonstrated that the reflected beam is split into two beams that are offset symmetrically with respect to the plane of incidence and exhibit elliptical polarization. An experimental setup is described in which the amount of splitting and polarization are determined. The theoretical and experimental results agree well. Figures 2; references 12: 5 Russian, 7 Western.  
[272-6900]

## OPTICAL INVESTIGATIONS OF SPIN WAVES EXCITED PARAMETRICALLY BY PERPENDICULAR PUMPING

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 16 May 83) pp 106-110

SOLOMKO, A. A., GAYDAY, Yu. A., DOVZHENKO, A. V. and KARPENKO, A. N.

[Abstract] Spin and magnetoelastic waves excited parametrically by transverse pumping ( $\omega_0 = 2.2$  to 4 GHz) in a tangentially magnetized yttrium ferrite garnet disc are investigated optically. The specimen is placed at the antinode of the magnetic field of a rectangular tuned cavity with  $Q \approx 25$ . Spin waves propagating along the constant magnetic field at frequency  $\omega_k = \omega_0/2$  are detected and investigated. The intensity of diffracted radiation on spin and transverse magnetoelastic waves is investigated as a function of the orientation of the external magnetic field with respect to crystallographic axes in the (110) plane. It is found that parametrically excited transverse magnetoelastic waves are excited most effectively with the constant magnetic field oriented along the [001] and [110] axes, and spin waves along the [111] crystallographic axes. No parametrically excited longitudinal magnetoelastic waves were detected, which indicates that their excitation threshold is higher than their spin waves. Figures 3; references 8: 5 Russian, 3 Western.  
[272-6900]

# PHASE EFFECTS DURING REFLECTION OF LIGHT FROM BOUNDARY OF MEDIA WITH SIMILAR INDICES OF REFRACTION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 29 Jun 84) pp 3-5

AL'TSHULER, G. B., YERMOLAYEV, V. S.

[Abstract] This study describes an experimental investigation of the manner in which the phase of the light wave changes upon reflection from a glass-liquid interface boundary as a function of the difference of the indices of refraction of these media near the point  $\Delta n = n_I - n_{II} = 0$ . Nonlinear optical effects associated with the relationship found between the phase and the difference between the indices of refraction are examined. The findings can be used to determine the linear and nonlinear optical characteristics of the surface of condensed media. Figures 1; references: 4 Russian. [272-6900]

# POSSIBILITY OF OPTIMAL CHOICE OF EXPOSURE TIME FOR HOLOGRAPHIC RECORDING OF OBJECTS THROUGH UNSTEADY SCATTERING MEDIA

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 28 Jan 83) pp 118-122

ANGEL'SKIY, O. V., YATSENKO, V. V. and DERKACH, D. I.

[Abstract] This study investigates the possibility of holographic measurement of the velocity distribution of Brownian particles in a scattering medium. An algorithm is developed for calculating the exposure time for holographing objects through unsteady scattering media. An experimental setup is described in which the scattering volume is illuminated with a collimated beam from an He-Ne laser ( $\lambda = 0.63 \mu\text{m}$ ). The measurement results agree well with results obtained by optical mixing spectroscopy. An optimality criterion is derived for selecting the exposure time in order to improve the quality of an image recorded holographically through an unsteady scattered medium. Figures 4; references 8: 5 Russian, 3 Western. [244-6900]

# INVESTIGATION OF QUALITATIVE CHARACTERISTICS OF IMAGE RECOVERED FROM HOLOGRAM WITHOUT REFERENCE BEAM

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85, pp 113-117

MOKHUN', I. I. and ROSLYAKOV, S. N.

[Abstract] The influence of the noise of a thin Fourier hologram with no reference beam on the recovered image is investigated. The hologram is viewed as consisting of a set of elementary holograms formed as the result of interference of the fields from all of the sources of the object with one another. The method employed for analyzing the holography process using no reference beam makes it possible to describe the structure of the recovered image satisfactorily. The findings indicate that a useful image, unburdened by noise, can be recovered from a thin Fourier hologram without a reference beam; the quality of the image depends strongly upon the phase composition of the radiation of the sources representing the holographed object.

Figures 2; references: 8 Russian.

[244-6900]

# INVESTIGATION OF RADIATION ABSORPTION EFFICIENCY AND DISTRIBUTION OF HEAT SOURCES WITHIN WEAKLY ABSORBING TWO-LAYER PARTICLES OF AQUEOUS AEROSOL UNDER OPTICAL RESONANCE CONDITIONS

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85 (manuscript received 26 Sep 83) pp 103-108

PRISHIVALKO, A. P., ASTAF'EVA, L. G., VEREMCHUK, M. S. and LEDNEVA, G. P.

[Abstract] The conditions supporting the occurrence of resonances in the absorption of radiation by two-layer spherical particles, as well as resonance-associated changes in the distribution of the absorbed energy (heat release) within such particles, are investigated. The absorption resonances of radiation at  $0.6943 \mu\text{m}$  by droplets of water with a surface shell of a weakly absorbing liquid such as aniline are analyzed. Various droplet dimensions and shell thicknesses are examined for which the conditions for resonance of magnetic and electrical partial waves are satisfied. It is found that a shell thickness can be selected for any droplet radius for which the magnetic or electrical partial wave with the required number is resonant. Quantitative data on the main maxima of the electrical energy density within particles of similar dimensions are tabulated. Figures 4; references 13: 4 Russian, 9 Western.

[244-6900]



## DISTRIBUTION OF RADIANT EMITTANCE AND LUMINANCE ON SURFACE OF LIGHT-SCATTERING SPHERE

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 9 Sep 83) pp 100-103

BORISEVICH, M. N., GAVRILOVICH, A. B. and IVANOV, A. P.

[Abstract] The model experiment method is employed to study the distribution of radiant emittance and luminance on a sphere illuminated by a parallel radiation beam. The experimental setup employed for the study is described. The ratios of radiant emittance and luminance to incident radiant flux as a function of angle are recorded. The luminance distribution along the meridional surface of a spherical scattering volume is analyzed.

Figures 4; reference: 1 Russian.

[244-6900]

UDC 531.341:621.373.8

## 1,3,2-DIOXABORINES--A NEW CLASS OF LASER DYES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 1, Jan 85  
(manuscript received 20 Mar 83) pp 51-55

VASIL'EV, N. N., GORELENKO, A. Ya., KALOSHA, I. I., MEZHENTSEV, V. A.,  
TISHCHENKO, I. G., TOLKACHEV, V. A., TULACH, V. Ya. and SHKADAREVICH, A. P.

[Abstract] This study presents the results of investigations of the spectral luminescent and lasing properties of 1,3,2-dioxaborines, which represent complex compounds of  $\beta$ -ketoaldehydes and ortho-oxychalcones, and which exhibit strong fluorescence in the visible region of the spectrum. The spectral-luminescence characteristics of solutions of the dyes are tabulated. The compounds exhibit strong fluorescence in the blue or red regions of the visible spectrum; the introduction of various impurities has a strong effect on the position of the absorption band and the emission of the dyes. The lasing parameters of the 1,3,2-dioxaborines are compared in tabular form with the characteristics of solutions of 1,4-di[2-(5-phenyloxazolyl)] benzole and oxazine-17. The synthetic 1,3,2-dioxaborines are found to be significantly less efficient than the other compounds; the efficiency of the solutions is practically the same as that of oxazine-17 solutions when pumped by a pulse flashlamp. The results indicate that 1,3,2-dioxaborines can be employed as activators for the working media in tunable lasers employing coherent and lamp pumping; the spectral-luminescence and lasing characteristics can be varied over a wide spectral range. References 10: 7 Russian, 3 Western.

[244-6900]

ALGORITHM FOR A POSTERIORI RECONSTRUCTION OF COMPLETE IMAGE OF DESTABILIZED OBJECT FROM SERIES OF ATMOSPHERE-DEGRADED BRIEF EXPOSURE IMAGES OF N DIFFERENT ASPECTS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 4, Oct 84  
(manuscript received 5 Aug 83) pp 743-746

BAKUT, P. A., SVIRIDOV, K. N., USTINOV, N. D. and KHOMICH, N. Yu.

[Abstract] An algorithm is proposed which makes it possible to construct a posteriori the complete image of a destabilized object from a series of atmosphere-degraded images of N different aspects. The procedure consists of reconstructing N instantaneous inverse Fourier transforms of the atmosphere-telescope system, obtaining N atmosphere-degraded images of different aspects of the object and then using them to form a complete image undistorted by the atmosphere: this makes it possible to solve the problem of 'seeing' the object through the turbulent atmosphere, as well as the problem of the apparent 'sickle' shape of the object when illuminated laterally by the sun. References 7: 4 Russian, 3 Western.  
[142-6900]

OFFSET OF IMAGE OF OBJECTS IN OPTICAL DETECTION AND RANGING WITH SEVERE INTENSITY FLUCTUATIONS IN TURBULENT ATMOSPHERE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 4, Oct 84  
(manuscript received 20 Jun 83) pp 732-734

AKSENOV, V. P., BANAKH, V. A. and CHEN, B. N.

[Abstract] This study presents the results of calculating the dispersion of the jitter of the image of a mirror disc and corner reflector in the presence of severe intensity fluctuations. Conditions are defined under which the expression for the image jitter of an infinite mirror and corner reflector for strong intensity fluctuations is entirely the same as the corresponding expression for weak intensity fluctuations. The variance of the jitter of the image from a flat mirror and from a corner reflector are analyzed as a function of the dimension of the receiving lens. Figures 2; references: 6 Russian.  
[142-6900]

## OPTIMIZATION OF MODULATION TRANSFER FUNCTIONS OF IMAGING SYSTEMS LOOKING THROUGH RANDOMLY HETEROGENEOUS MEDIA

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 4, Oct 84  
(manuscript received 21 Apr 83) pp 691-695

VALENTYUK, A. N. and METELITSA, S. I.

[Abstract] A method is developed for finding the optimum modulation transfer functions of imaging systems designed to obtain information through a randomly heterogeneous medium. The method is based on Pontryagin's maximum principle. The maximum principle to find the optimum modulation transfer functions of imaging systems is found to improve the efficiency of systems operating in randomly heterogeneous media. It is demonstrated that the best image quality is provided by optical imaging systems which are 'matched' in a defined sense with the characteristics of the randomly heterogeneous layer between the observed object and the optical receiving system. The relationship between the modulation transfer function of a randomly heterogeneous layer and the optimum transfer function of the imaging system is found. The findings can be used to solve other problems involved in matching the elements of multi-section imaging systems. Figures 2; references: 6 Russian.  
[142-6900]

## INVESTIGATION OF FLUCTUATIONS IN POLARIZABILITY OF MACROSCOPICALLY HOMOGENEOUS MEDIA SCATTERING COHERENT RADIATION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 4, Oct 84  
(manuscript received 31 Mar 82) pp 647-651

BEL'GOVSKIY, I. M., KORNIYENKO, G. N., VINOGRADOVA, Ye. K., DAVYDOVA, A. B. and YENIKOLOPOV, N. S.

[Abstract] The statistical properties of coherent scattering of radiation on a homogeneous solid transparent object rotating at a fixed angular velocity are employed directly to measure the correlation function of the fluctuations of the polarizability of the object under investigation. An expression is derived for the power spectrum of the detector photocurrent. The connection is identified between the fluctuation spectrum of the scattered light intensity and the correlation function of the fluctuations in the dielectric constant of the medium for a spherical scattering body. An experimental method is proposed for measuring the correlation function of the squares of the fluctuations of the polarizability of the medium. Figures 3; references 20: 6 Russian, 14 Western.  
[142-6900]

GENERAL-PURPOSE EQUIPMENT FOR AIRBORNE LASER REMOTE SENSING OF OCEAN,  
ATMOSPHERE AND AGRICULTURAL CROPS

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 17 Jan 84) pp 2190-2195

BUNKIN, A. F., VLASOV, D. V., GLAUMYAN, A. S., MAL'TSEV, D. V.,  
MIRKAMILOV, D. M. and SLOBODYANIN, V. P., General Physics Institute,  
USSR Academy of Sciences.

[Abstract] A general-purpose airborne laser remote sensing system is described for ocean and land research from altitudes of 800-1200 meters for obtaining information on the thermodynamic parameters of the ocean, currents, ocean depth, and the condition and yield of agricultural crops. The system, which is carried aboard an AN-30 aircraft, employs fluorescent spectroscopy to determine small concentrations of organic impurities in sea water. The airborne system is described in detail; the results of measurements made during flights over numerous bodies of water and land areas are discussed. The development of this system opens up fundamentally new capabilities for laser spectroscopy in environmental pollution monitoring, and for mapping currents and turbulence in the ocean, as well as diagnosing crop yields. Figures 6; references 9: 4 Russian, 5 Western.  
[151-6900]

## LASER DOPPLER METHODS FOR MEASURING SPATIAL STRUCTURE OF TURBULENCE

Moscow TEPILOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 5, Sep-Oct 84  
(manuscript received 14 Apr 83) pp 956-964

RINKEVICHYUS, B. S., SMIRNOV, V. I. and TIMOFEEV, A. S., Moscow Power  
Engineering Institute.

[Abstract] This study investigates the use of two groups of laser anemometers for measuring the spatial structure of turbulence: devices employing dual-beam interferometry, and devices employing intensity interferometry. The theory and instrumentation for both methods are analyzed. The former are found to be effective in flows containing a high concentration of scatterers when high-sensitivity photodetection equipment is used; the need for using systems to match the scattered beams, and the conditions imposed on the concentration of the scattering centers, hinder the use of these systems for a number of hydrodynamic problems. Dual-beam laser Doppler anemometry can be used to measure the single-point correlations of the orthogonal components of the velocity vector directly. Figures 4; references 17: 16 Russian, 1 Western.  
[164-6900]

## ESTIMATION OF DEVIATIONS OF SPECTRAL CHARACTERISTICS OF OPTICAL COATINGS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 7 Jun 83) pp 192-194

GRISHINA, N. V. and TIKHONRAVOV, A. V.

[Abstract] A statistical approach is proposed for assessing the influence of errors in the parameters of the layers on deviations of the spectral characteristics of coatings from the calculated values. The expected influence of errors on the transmission factor of an antireflection coating for the 0.4-0.8  $\mu\text{m}$  region is investigated as an example of the method. It is found that errors in the parameters of the layers of synthesized systems may significantly degrade the spectral properties of the systems. The estimation of deviation of the spectral characteristics can be used to select optimum systems with allowance for errors in the parameters. Figures 1; references 8: 4 Russian, 4 Western.  
[272-6900]

UDC 620.179.11:535.321

## ELLIPSOMETRIC INVESTIGATION OF OPTICALLY POLISHED SURFACE OF COPPER

Moscow POVERKHNOST'. FIZIKA, KHIMIYA, MEKhanIKA in Russian, No 2, Feb 85  
(manuscript received 13 Feb 83) pp 132-138

CHURAYEVA, M. N., ZORIN, Z. M. and PERSIANTSYEVA, V. P., Physical Chemistry Institute, USSR Academy of Sciences

[Abstract] The surface of massive copper specimens (Cu 99.99%) polished by means of diamond paste is investigated ellipsometrically. Copper was employed because of the extensive use of copper mirrors in technical devices, and because the constants of copper have been determined reliably by an independent method. Optical models of the copper surface are examined; the differences between the measured and calculated ellipsometric angles did not exceed the experimental error, meaning that the amount of error cannot always be used as a reliable criterion for selecting a model. Optimization of ellipsometric measurements made at three wavelengths within the framework of a model that allows for the presence of oxides in the transitional layer provides the best results for a diamond-paste polished massive copper surface. The optical constants of the massive specimens measured ellipsometrically agree well with findings for sputtered copper films measured in another study by the reflection-transmission method. Ellipsometric measurement of the thickness of the inhibitor layer on the polished copy surface indicates that a mono- or bi-molecular inhibitor layer is adsorbed. Figures 3; references 13: 4 Russian, 9 Western.  
[273-6900]

# RELATIONSHIP BETWEEN CHEMICALLY HETEROGENEOUS STRUCTURE OF GLASS AND OPTICAL BREAKDOWN THRESHOLD

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 11, No 9, Sep 84  
(manuscript received 27 Dec 83) pp 1840-1842

KARAPETYAN, G. O. and MAKSIMOV, L. V., Leningrad Polytechnical Institute  
imeni M. I. Kalinin

[Abstract] The connection between heterogeneous glass structure and the optical breakdown threshold is established through Rayleigh and Mandelstam-Brillouin spectroscopy for various glasses. The relationship between the optical breakdown threshold and the Landau-Placzek ratio is found from the scattered light spectra for quartz glass and for LK6, F1, F2, TF1 and TBF3 glasses. It is found that glasses with a high optical breakdown threshold are characterized by low refraction indexes with minimum fluctuations. The latter can be achieved through high structural and chemical homogeneity of the glass, or by employing elements with low atomic polarizability. The proposed model explains the drop observed in the optical breakdown threshold when lead is introduced in the alkali-silicate matrix. The breakdown threshold is shown to decrease as the Landau-Placzek ratio increases. Data from scattered light spectroscopy can be used to find glasses with high optical breakdown thresholds. Figures 2; references 15: 10 Russian, 5 Western.  
[100-6900]

## EXCITATION OF NONLINEAR SURFACE WAVES BY GAUSSIAN LIGHT BEAMS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI in Russian  
Vol 88, No 1, Jan 85 (manuscript received 25 Jun 84) pp 107-115

AKHMEDIYEV, N. N., KORNYEYEV, V. I., KUZ'MENKO, Yu. V., Moscow Electronic Engineering Institute

[Abstract] The interaction of Gaussian light beams incident at glancing angles to the surface of a nonlinear medium and nonlinear surface waves is analyzed numerically by means of a parabolic equation derived from the wave statement of the problem as a wave varying slowly along the boundary. It is found that nonlinear surface waves at an interface boundary may be either stable or unstable, depending upon their effective index of refraction. Stable as well as unstable nonlinear surface waves can be excited by Gaussian light beams incident at glancing angles on the interface from a linear medium. A Gaussian beam excitation of unstable nonlinear surface waves can cause a huge Goos-Hanchen effect, in which the reflected beam is shifted with respect to the geometric line of reflection. Figures 5; references 12: 8 Russian, 4 Western.  
[266-6900]

# DISTINCTIVE FEATURES OF COHERENT AMPLIFICATION OF RADIATION IN PUMPING DIRECTION DURING RESONANT RAMAN SCATTERING

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI in Russian Vol 88, No 1, Jan 85 (manuscript received 11 May 84) pp 47-59

BOL'SHOV, L. A., YELKIN, N. N., LIKHANSKIY, V. V. and PERSIANTSEV, M. I.

[Abstract] This study investigates nonlinear Stokes wave capture in coherent resonant Raman scattering. It is found that nonlinear capture occurs in the region of pulse interaction over a wide range of parameters of the resonant medium, making the coherent Raman scattering highly efficient. In addition to amplification, dispersion of the Stokes wave, which causes the formation of coupled pulse states, plays an important role. Conversion efficiency of near 100% is demonstrated by soliton solutions obtained by the inverse scattering method. Figures 4; references 11: 8 Russian, 3 Western.  
[266-6900]

UDC 535.36:548.0

# PHOTOINDUCED RAYLEIGH SCATTERING OF LIGHT IN CRYSTALS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 2, Feb 85 (manuscript received 27 Jul 83) pp 378-385

OBUKHOVSKIY, V. V. and STOYANOV, A. V.

[Abstract] The intensity of light scattered by inhomogeneities of the dielectric constant of ferroelectric crystals was calculated theoretically. It was shown that the scattering intensity is a sum of two terms: one due to scattering by inhomogeneities present initially and the other due to scattering by inhomogeneities which are induced by the exciting radiation (photogalvanic inhomogeneities). The scattering process was shown to be markedly nonstationary. Both components of the scattering intensity increase with time, but the second component of the scattering is absent initially and approaches a finite value at infinite time. The dynamic behavior of the scattering intensity was shown to be very sensitive to the statistical properties of the exciting radiation. For incoherent light the scattering intensity relaxes to a steady-state value within a time of the order of the dark relaxation time. In the case of coherent light, however, a holographic pattern is formed as a result of the interference of the pump wave with the induced wave. It was shown that the study of the dynamic behavior of the scattering intensity provides an independent means for determining the coefficients of photoconductivity and dark conductivity as well as the saturation optical inhomogeneity. Figures 2; references 15: 11 Russian, 4 Western.  
[317-9638]

## MULTIPHOTON RAMAN SCATTERING OF LIGHT EXCITED IN CRYSTALS BY A COPPER-VAPOR LASER

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 2, Feb 85  
(manuscript received 10 Oct 83) pp 386-389

AGAL'TSOV, A. M., GORELIK, V. S. and SUSHCHINSKIY, M. M.

[Abstract] Multiphoton Raman scattering was excited in lithium tantalate and potassium chloride crystals with a copper-vapor laser emitting at two wavelengths  $\lambda=510.6$  nm and 578.2 nm. The laser operated in a quasicontinuous mode: the pulse repetition frequency was equal to  $\approx 8$  kHz. The pulse power and pulse duration were equal to 20 kW and 15 nsec, respectively. In lithium tantalate, the multiphoton Raman scattering was studied near the second optical harmonic ( $\lambda=289.1$  nm) under excitation with the laser radiation at  $\lambda=578.2$  nm (the radiation at  $\lambda=510.6$  nm was suppressed with a filter) as well as in the region of the sum ( $\lambda=271.1$  nm) under excitation with laser radiation at both wavelengths. In potassium chloride, three-photon scattering was studied near the second optical harmonic ( $\lambda=289.1$  nm). The intensity of the exciting light was equal to  $\approx 10^8$  W/cm<sup>2</sup> for lithium tantalate and  $2 \cdot 10^8$  W/cm<sup>2</sup> for potassium chloride. The scattered radiation was recorded in the continuous mode at 300 K with a spectral resolution of 10-50 cm<sup>-1</sup>. Figures 4; references 8: 6 Russian, 2 Western.  
[317-9638]

UDC 535.80

## PHASING OF MULTIPLE-APERTURE OPTICAL SYSTEMS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 2, Feb 85  
(manuscript received 1 Feb 84) pp 445-448

BAKUT, P. A., RAYAKIN, A. D., SVIRIDOV, K. N. and USTINOV, N. D.

[Abstract] Image-sharpness functions of the form  $\int d\vec{x} I^2(\vec{x})$  (a) and  $\int d\vec{x} (I(\vec{x}) - \sum I_{\ell\ell}(\vec{x}))^2$  (b), where  $I(\vec{x})$  is the intensity distribution in the image of a point source formed by a multiple-aperture system,  $I_{\ell\ell}(\vec{x})$  is the intensity distribution in the image of an object formed by the  $\ell$ -th sub-aperture separately, and the summation extends over all apertures  $\ell=1, \dots, N$ , were studied for the problem of phasing multiple-aperture systems. Phasing is achieved by maximizing the image-sharpness function. From an examination of the optical transfer function of the system it was determined that type (a) image-sharpness functions are acceptable in the absence of phase distortions of the wave front while type (b) functions are acceptable in the presence of phase distortions. References 7: 2 Russian, 5 Western.  
[317-9638]



# ON THE REDEFINITION OF THE ENERGY COEFFICIENTS OF REFLECTION AND TRANSMISSION OF LIGHT AT THE INTERFACE BETWEEN ABSORBING AND TRANSPARENT MEDIA

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 2, Feb 85  
(manuscript received 2 Jan 84) pp 466-469

MINKOV, I. M.

[Abstract] It was shown that the problem of redefining the energy coefficients of reflection (R) and transmission (T) so as to preserve the relation  $R + T = 1$  in the presence of incident, reflected, transmitted, and interference fluxes can be avoided by treating the interference fluxes as absorption in a fictitious layer in the absorbing medium. Figures 1; references 10: 4 Russian, 6 Western.  
[317-9638]

UDC 535.34

## ABSORPTION OF RADIATION IN MULTILAYERED SPHERICAL PARTICLES

Minsk VESTSI AKADEMII NAVUK BSSR SERYYA FIZIKA-MATEMATYCHNYKH NAVUK  
in Russian No 1, Jan-Feb 85 (manuscript received 12 Apr 83) pp 55-60

BABENKO, V. A. and ASTAF'YEVA. L. G., Physics Institute, Belorussian SSR Academy of Sciences.

[Abstract] Analytical formulas are derived for calculating the energy absorption in an arbitrary concentric layer isolated within a spherical particle with an incident plane monochromatic electromagnetic wave. In contrast to the method in which certain integral absorption characteristics are found, the proposed method makes it possible to determine how much energy is absorbed in a particular isolated region within a particle. Figures 1; references 8: 6 Russian, 2 Western.  
[299-6900]

# INFLUENCE OF SPATIAL COHERENCE OF LIGHT SOURCE ON INTENSITY DISTRIBUTION OF REFLECTED RADIATION IN FOCAL PLANE OF TELESCOPE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 58, No 1, Jan 85  
(manuscript received 11 May 83) pp 111-115

BANAKH, V. A., BULDAKOV, V. M. and MIRONOV, V. L.

[Abstract] The amplification of backscattering in the focal plane of the receiving lens is investigated as a function of the initial coherence of the source and the diffraction dimensions of the lens and transmitting aperture for the case of reflection from a diffuse surface. The intensity distribution of the reflected radiation in the focal plane of the telescope, as well as the gain, are analyzed for strong and weak turbulence along the propagation path. It is found that the gain decreases and becomes saturated as the degree of correlation of the source decreases, with saturation occurring at a level that depends upon the diffraction dimensions of the radiator, the reflector and the lens of the receiving telescope, as well as the intensity of the turbulence. Figures 3; references: 8 Russian.  
[272-6900]

# A COMPLEX EIKONAL AND ITS APPLICATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 5, Dec 84  
(manuscript received 24 Jan 84) pp 1087-1091

ANAN'EV, Yu. A.

[Abstract] This study investigates the eikonal - the optical distance measured along a beam between corresponding points on the input and output planes - for the complex case, in which the system in question incorporates phase as well as quadratic amplitude correctors. The possibility of using the complex eikonal is demonstrated by a number of typical examples. The establishment of equivalence among optical systems is described. Propagation laws are described for 'self-reproducing' beams. The behavior of off-axis Gaussian beams is analyzed. The operation of stable cavities with finite mirrors is calculated. References 5: 4 Russian, 1 Western.  
[290-6900]

## NONLINEAR SCATTERING OF LIGHT ON STATIC OPTICAL INHOMOGENEITIES

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 2, Feb 85  
(manuscript received 17 May 83) pp 315-321

AL'TSHULER, G. B. and YERMOLAYEV, V. S.

[Abstract] The propagation of plane waves is investigated theoretically for nonlinear scattering on static optical inhomogeneities in transparent, absorbing and amplifying media. The conditions under which a strong interaction effect can be expected due to nonlinear light scattering are examined. The basic principles underlying the evolution of an intense light wave in an isorefractive medium is examined. It is found that nonlinear scattering on static optical inhomogeneities in an isorefractive medium causes strong light self-interaction. Figures 2; references 15: 14 Russian, 1 Western.  
[301-6900]

UDC 535.327:621.375.826

## TRANSFORMATION OF LIGHT PULSE SHAPE BY THIN PLANE-PARALLEL LAYER OF ABSORBING MATERIAL

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 42, No 2, Feb 85  
(manuscript received 23 Nov 83) pp 255-259

INSAROVA, N. I. and OLEFIR, G. I.

[Abstract] The properties of the reflection of radiation by a plane-parallel absorbing layer on the characteristics of a powerful light pulse that is reflected from or passes through the layer are investigated. The case of self-interaction is studied, i.e., the case in which the thermal nonlinearity of the index of refraction of the layer is caused by the incidence of the radiation on the layer at some angle  $\alpha$  that is smaller than  $\alpha_0$ . It is found analytically and experimentally that the shape of the pulse that is reflected or passed through the layer can differ greatly from that of the incident pulse due to variation in the refractivity of the layer due to heating caused by the incident pulse. Layers that exhibit this property can be employed in quantum electronic devices as general-purpose high-sensitivity nonlinear elements. Figures 4; references 7: 6 Russian, 1 Western.  
[301-6900]

## CONVEX X-RAY BAND ROTATING MIRRORS. I

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 55, No 2, Feb 85  
(manuscript received 6 Jul 84 after revision) pp 244-250

VINOGRADOV, A. V., KOVALEV, V. F., KOZHEVNIKOV, I. V. and PUSTOVALOV, V. V.,  
Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The basic characteristics of reflecting elements based on convex cylindrical surfaces are examined in the approximation of geometric optics. The coefficients of reflection of convex cylindrical mirrors and their angular and dispersion properties are compared with the like properties of flat glancing-incidence mirrors. It is found that convex cylindrical surfaces can effectively rotate X-radiation through large angles. In contrast to multi-layered structures, convex cylindrical mirrors have a high coefficient of reflection over a wide range of wave lengths. Figures 8; references 12; 6 Russian, 6 Western.  
[300-6900]

UDC 530.12:531.51

RESONANT GENERATION OF PLASMA OSCILLATIONS BY PLANE GRAVITY WAVE

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 28,  
No 1, Jan 85 (manuscript received 28 Oct 83) pp 74-78

IGNAT'YEV, Yu. F., Kazan' State University imeni V. I. Ul'yanov-Lenin

[Abstract] An exact solution of the kinetic equation (which employs a model collision integral obtained previously by the author) is used to find the exact solution of the general-relativistic Maxwell equations, linearized with respect to the amplitude of the induced field. A gravity wave in a plasma-like medium results in two oscillation modes: a non-attenuating one at the frequency of the gravity wave, and an attenuating one at the plasma frequency. Resonance occurs when these frequencies coincide, which causes the amplitude of the electrical oscillations to increase abruptly. The case of anisotropic distribution of degenerate electrons, which is realized in metals, is examined. It is noted that the findings are applicable rigorously only to unbounded media; the development of resonance in a bounded volume of metal requires that certain relationships hold between the length of the specimen and the wavelength. References: 1 Russian.  
[262-6900]

UDC 530.12:531.51

STOCHASTIC QUANTIZATION AND (FIRST-ORDER) RENORMALIZATION OF  $n$ -FIELD MODEL

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 28,  
No 1, Jan 85 (manuscript received 15 Nov 83) pp 3-6

VAYSBURD, I. D., Siberian Physical-Technical Institute imeni V. D. Kuznetsov,  
Tomsk State University

[Abstract] The stochastic quantization method, which is based on using the Langevin equation describing the nonequilibrium dynamics of the system to quantize the Parisi-Wu theory, is investigated. Renormalization of the coupling constant in the  $n$ -field model during stochastic quantization is demonstrated and shown to be independent of the parameters of the  $n$ -field.

The Gell-Mann and Low function is obtained to within the first order. Polyakov and Brezin's finding is replicated, and an equation is derived for the average field that serves as the background for the rapidly fluctuating field. References 4: 1 Russian, 3 Western.  
[262-6900]

UDC 532.517.4

#### CREATION OF MULTIDIMENSIONAL CHAOS IN ACTIVE LATTICES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 3, Nov 84  
(manuscript received 14 Feb 84) pp 596-601

GAPONOV-GREKHOV, A. V., academician, USSR Academy of Sciences,  
RABINOVICH, M. I. and STAROBINETS, I. M., Applied Physics Institute,  
USSR Academy of Sciences.

[Abstract] Periodic networks of coupled feedback oscillators are proposed as a natural model within whose framework it is possible to detect developed chaos and its image - a multidimensional strange attractor - and to answer some of the questions associated with the origin and nature of developed chaos. The mechanism underlying the abrupt occurrence of high-dimensionality attractors is explained by analyzing the phase space of the system. The strange attractor dimensionality used to estimate the degree of turbulence in the system is found through the average Lyapunov characteristic trajectories on the attractor. Figures 4; references 12: 2 Russian, 10 Western.  
[162-6900]

UDC 537.533.3

#### FOCUSING OF CHARGED-PARTICLE BEAMS BY INHOMOGENEOUS MAGNETIC FIELD

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 54, No 11, Nov 84  
(manuscript received 22 Feb 84) pp 2249-2252

BURSHTEYN, E. L. and ROGINSKIY, L. A.

[Abstract] The dynamics of particles in beams in a steady-state inhomogeneous axisymmetrical magnetic field is employed to investigate the influence of the edge field of the solenoid on radial and longitudinal particle movement, as well as the envelope dynamics of an intense beam. It is shown numerically and analytically that the edge field of the focusing solenoid has a strong influence on the radius of the cyclotron orbit of particles within the solenoid. An envelope equation is derived from linearized movement equations that allows for the influence of the edge field on the radius of an intense beam. Inasmuch as linearized equations of motion can be employed, the familiar envelope method can be extended to

the case of collective particle movement in the edge field of the focusing solenoids. Figures 1; references 6: 5 Russian, 1 Western.  
[151-6900]

#### TOWARD A THEORY OF LOW FREQUENCY MAGNETOSONIC SOLITONS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKIY FIZIKI in Russian  
Vol 88, No 1, Jan 85 (manuscript received 31 May 84) pp 189-204

MIKHAYLOVSKIY, A. B. and SMOLYAKOV, A. I., Moscow Physical-Technical  
Institute

[Abstract] Low frequency magnetosonic solitons propagating perpendicular to a magnetic field in a high temperature magnetized collisionless plasma are investigated in order to resolve the contradictory findings of earlier studies, one of which treated solitons as rarefaction solitons, while others treated them as compression solitons. Both kinetic and hydrodynamic descriptions of dispersion are analyzed in order to obtain the physical results. Two cases are examined: one with a Maxwellian plasma with finite  $\beta$  and identical ion composition, and the other with a non-Maxwellian particle velocity distribution with maximally small  $\beta$  and multicomponent ion composition of the plasma. It is shown that weak ion-ion collisions cause the attenuation of low frequency magnetosonic solitons, rather than the formation of magnetosonic shock waves. Special cases of magnetosonic solitons are investigated: it is shown that the dispersion of low frequency magnetosonic waves is sensitive to the details of the distribution function of the plasma ions. It is shown that the dispersion of a cold plasma is determined by the finite ratio of the electron mass to the ion mass only for ions of the same kind, while the dispersion may be significantly greater in a plasma with an admixture of ions with a different charge-to-mass ratio. Gyrorelaxation attenuation of low frequency magnetosonic solitons is found to be a stronger effect than the transverse collision viscosity examined previously in connection with the problem of shock waves. References 19: 19 Russian, 9 Western.  
[266-6900]

## PROPAGATION OF WAVE PACKETS IN NONLINEAR AMPLIFYING (ABSORBING) MEDIA

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 55, No 2, Feb 85  
(manuscript received 20 Feb 84) pp 233-243

BASS, F. G., NASONOV, N. N. and CHERNYSHOV, V. V., Radio Physics and  
Electronics Institute, Ukrainian SSR Academy of Sciences.

[Abstract] The propagation of quasimonochromatic wave packets (envelope solitons) in weakly nonlinear amplifying or absorbing media is investigated. It is found that an amplified envelope soliton moves as a unified whole in wave number space in the direction of increasing increment values. For the case of absorption, the soliton moves in  $k$ -space toward the region of small attenuation decrement values from the region of large values. Spectrum broadening caused by the increased soliton amplitude due to amplification is found to cause saturation of the soliton amplitude during amplification under certain conditions. The evolution of envelope solitons of spin-helical waves in ferromagnetic semiconductors is analyzed as an example. Figures 4; references 13: 12 Russian, 1 Western.  
[300-6900]



HYDROTHERMODYNAMICS OF THE NEAR-SURFACE LAYER OF A LIQUID AND OPTICAL METHODS OF INVESTIGATING IT

Kiev VISNYK AKADEMIYI NAUK UKRAYINS'KOYI RSR in Ukrainian No 11, Nov 84, pp 15-21

[Article by O. D. Fedorovs'kyi, corresponding member, Ukrainian RSR Academy of Sciences and Ye. I. Nykyforovych, Candidate of Physical-Mathematical Sciences]

[Text] Among the most important practical tasks of hydromechanics is the determination of the heat flow between reservoirs and the atmosphere. To solve it, one must have detailed information on the temperature distribution at the air-water interface, which is obtained today by both contact and remote methods. It should be pointed out, however, that those methods do not take into consideration the complex thermohydrodynamic structures which form in water layers near the surface, with dimensions of the order of millimeters. In some cases this leads to considerable errors.

Another important practical task is diagnosis of the dynamic processes which take place in the ocean by methods of remote sensing of the surface [1]. In this direction only the first steps have been made. In [2] are given the results of the remote measurement of the spatial scale and the values of the temperature anomalies of a homogeneous ocean layer. On the basis of the obtained results it has been concluded that there is a possibility of determining the dimensions and energy of the synoptic vortex and indications of the parameters of internal waves through characteristic thermal radiations of the free surface of the ocean in the infrared region of the spectrum.

Obviously the tasks of diagnosis also require consideration of complex hydrothermodynamic phenomena which are in evidence on the air-water interface. An example of such phenomena can be the cold and warm films, or thermal boundary layers, formed in the layer near the water surface [3-6]. In those thin layers with dimensions on the order of several millimeters a temperature drop of several degrees is observed.

In the case of a cold film (a water surface temperature below the temperature at a depth of several millimeters) in the layer near the surface an unstable

stratification forms which can evoke convective movements in it. In turn the convective movement affects the thermal structure of that layer. Under certain conditions, for example, during the cooling of water in a free surface, the cold upper surfaces sink deep in the liquid in the form of cold thermals. The process of their formation has a periodic character.

No less complex is the thermal structure formed near the interface, and correspondingly, the approximate temperature dependence is further complicated. This also reflects the hydrodynamic picture forming in the fine layers of liquid near the surface.

Experimental study of the hydrothermodynamics of such layers near the surface is connected with significant difficulties as a result of their small dimensions and the impossibility in a number of cases of using contact measurement apparatus. Very promising from this point of view, therefore, are remote methods of investigation and, in particular, with the use of infrared radiometers, which enable temperature determination in the upper layer of water with a thickness of 50 micrometers, and schlieren apparatus which permits obtaining a hydrodynamic picture in the layer near the surface.

The working principle of infrared radiometry consists in the registration of the characteristic radiation of an aqueous medium in the optical range and transformation of the received radiation into an electric signal, which depends on the temperature distribution on thin layer near the water surface. As is known, water has a total absorption coefficient, the value of which depends on the wavelength  $\lambda$ . Consequently in such a medium there are fluxes of characteristic radiation which are subject only to partial absorption in the characteristic way in the given medium. A portion of the characteristic radiation reaches the medium boundary as surface radiation, the main part of which comes from the layers near the surface which bounds the medium. The intensity of the monochromatic characteristic radiations of the medium depends on the temperature distribution in it and the wavelength.

From simple physical considerations it follows that the characteristic radiation of the half-infinite plane layer of such a medium is formed by a layer of finite thickness, distinguished, in particular, by examining the range of wavelengths. Obviously, the larger the absorption coefficient to the monochromatic radiation, the smaller the thickness of the layer which forms the given radiation, and vice versa. Consequently, by measuring the characteristic infrared radiation of such a medium in different ranges of wavelengths it is possible to get information on the thermal structure of the layer near the surface. If one neglects scattering in that local thermodynamic equilibrium, for the thickness of the radiation layer one can derive the formula:

$$z_{eff} = \int_{\lambda_1}^{\lambda_2} \epsilon_{\lambda} \alpha_{\lambda} \frac{dm_{\epsilon}(\lambda, T_0)}{dz} d\lambda / \int_{\lambda_1}^{\lambda_2} \epsilon_{\lambda} = \frac{dm_{\epsilon}(\lambda, T_0)}{dz} d\lambda. \quad (1)$$

Here  $(\lambda_1 \lambda_2)$  is the interval of received wavelengths;  $m_e(\lambda_1 T)$  is the Planck function;  $T_0$  is the surface temperature and  $\epsilon_\lambda$  is the surface radiation coefficient.

In formula (1) the Planck function is represented by a Taylor series relative to the surface temperature. Temperature changes on wavelengths of the order of  $\alpha_\lambda^{-1}$  were considered small. It follows from (1) that at  $\lambda_2 \rightarrow \lambda_1$  the thickness of the radiation layer becomes equal to inverse values of the absorption coefficient  $\alpha_\lambda^{-1}$ .

A sufficiently detailed exposition of the working principles and technical realization of infrared radiometry can be found in [7]. Described there is the use of schlieren devices to study hydrodynamic phenomena.

We will examine a theoretical model of the thermal structure of the water-vapor interface with consideration of external radiation. It is supposed that water and vapor are absorptive media with a flat interface, the vapor is a perfect gas with constant specific heats; and the water is an incompressible viscous liquid. The boundary conditions for the temperature are its constant values far from the interface. On the boundary surface, conservation of mass energy transfer and temperature difference between the water and vapor are used. In such a situation the surface temperature and heat flux are functions of the parameters of the problem--the intensity of the external radiation, the optical properties of the media, the vapor and water temperatures far from the interface, etc.

Under these conditions, the temperature distribution of the vapor and water and the surface temperature have the following form (the subscripts v and w relate to the vapor and water respectively, the subscript s to the values of parameters taken on the water surface):

$$T_v^* = \frac{I_0^v z_v}{\lambda_v T_{v\infty}} \exp(z^*) \int_{z_v^*}^{\infty} \exp\left(\int_{z_v^*}^{\infty} \kappa_v dt\right) \left(1 - \exp\left(-2 \int_0^{z_v^*} \kappa_v dt\right) \times \right. \\ \left. \times \exp(-t) dt - \frac{z_v I_0^v}{\lambda_v T_{v\infty}} (1 - \exp(-2h)) + 1, \quad (2)$$

$$T_w^* = \left(\frac{T_s}{T_{w\infty}} - 1 + \frac{I_0^w z_w}{\lambda_w T_{w\infty}(\gamma_w - 1)}\right) \exp(z^*) - \\ - \frac{I_0^w z_w}{\lambda_w T_{w\infty}(\gamma_w - 1)} \exp(\gamma_w z_w) + 1; \quad (3)$$

$$T_s = T_{v\infty} \left(1 - \frac{z_v I_0^v}{\lambda_v T_{v\infty}} \int_0^{\infty} \exp(-z^*) \left(1 - \exp\left(-\int_{z_v^*}^{\infty} \kappa_v dt\right) + \right. \right. \\ \left. \left. + \exp(-2h) \left(\exp\left(\int_{z_v^*}^{\infty} \kappa_v dt\right) - 1\right) dz^*\right); \quad (4)$$

here  $T_v^* = T_v/T_{v\infty}$ ,  $T_{v\infty}$  is the vapor temperature far from the interface  $z = 0$ ,  $T_w^* = T_w/T_{w\infty}$ ,  $T_{w\infty} = T_w(z = -\infty)$ ,  $I_0$  is the flux of radiant energy, averaged over frequency, in the vapor far from the interface,  $\lambda_v$  is the coefficient of thermal conductivity of the vapor,  $z_0 = \lambda_0/C_0$ ,  $C_{v,w}$  is the heat capacity of the vapor (water) at a constant volume,  $\sigma$  is the water evaporation rate,  $Z^* = z/z_w$ ,  $z_w = \lambda_w/C_w$ ,  $I_0^w$  is the flux of radiant energy at  $z = 0$ , directed into the water,  $\kappa_w, \kappa_v$  is the radiation absorption coefficient of water and vapor respectively,  $h$  is the optical density of the vapor,  $T_s$  is the surface temperature. The solution is written in a system of coordinates with respect to the vapor-water interface.

In [5] a phenomenon studied experimentally by means of infrared radiometry was described when, during certain decreases of hydrometeorological conditions in the sky, cloudiness contributed to reductions of temperature on the sea surface.

With formula (4) it is not difficult to show that, with increases of the intensity of external radiation, the interface temperature decreases, and vice versa. The given phenomenon can be explained by the fact that to fulfill the law of energy conservation on the interface during increased intensity of external radiation it is necessary to increase the flow on the part of the water, which is achieved, in particular, by intensifying the evaporation. In the final summing up this also leads to reduction of the surface temperature.

Let us examine in greater detail the theoretical profiles of temperature in water (3). We will call the surface "cold" if it has a temperature below that of the liquid at infinity, and "warm" if it is higher than that temperature. The criterion of existence of those surfaces can be written in the form

$$F = T_s/T_{w\infty} - 1 \geq 0,$$

where  $T_s$  is given by formula (4). It is not difficult to show that at  $T_{p\infty} < T_{w\infty}$  there exists only a cold surface. It follows from (3) that the temperature distribution in the liquid can have an inverse character. For the extremum we get:

$$z_0^* = (1 - \gamma_w)^{-1} \ln \frac{\beta \gamma_w}{F + \beta}, \quad \beta = \frac{I_0^w z_w}{\lambda_w T_{w\infty} (\gamma_w - 1)}, \quad \gamma_w = \kappa_w z_w. \quad (5)$$

Under ordinary conditions  $\gamma_w > 1$ , and so a temperature extremum exists if the parameters of the problem satisfy the condition

$$\frac{\beta \gamma_w}{F + \beta} > 1. \quad (6)$$

Let us note that the local extremum is always the maximum. The value of the maximum temperature is given by the formula

$$T_{\max}^* = 1 + (F + \beta) \left( \frac{\beta \gamma_w}{F + \beta} \right)^{1/(1-\gamma_w)} (1 - \gamma_w^{-1}).$$

Condition (6) can be solved as a limitation on the surface temperature. In fact, after simple transformations of formula (6) it is obtained that the temperature extremum in a liquid exists when the surface temperature satisfies the inequality:

$$1 - \beta < T_s/T_{w\infty} < 1 + \beta(\gamma_w - 1). \quad (7)$$

The temperature distribution in a liquid is given on Figure 1, from which it follows that with elevation of the surface temperature the temperature maximum rises, and its coordinate is displaced to the interface, and for a warm surface with  $T_s^* \geq 1 + \beta(\gamma_w - 1)$  the maximum disappears. Thus under certain conditions the existence of fine surface layers with temperature inversion is possible. Let us note that different temperature profiles in the liquid can correspond to a single temperature distribution in the vapor, and moreover, temperature distributions with and without inversion can correspond to the same value of  $T_{w\infty}$ . It follows from inequality (6) that the presence of a temperature inversion depends on the values of intensity of external radiation. Possible temperature distributions in the vapor and liquid are shown on Figure 2 in the case of temperature inversion; above the extremum point an unstable temperature stratification emerges, which in a number of cases leads to synchroconvection in the vapor  $[0, z_0^*]$ .

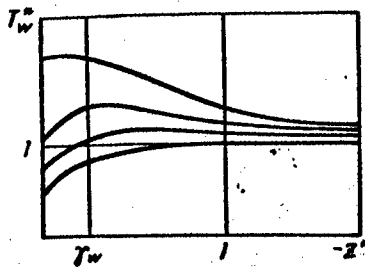


Figure 1

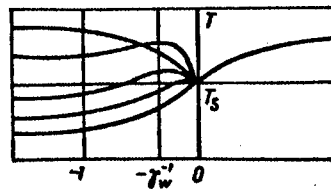


Figure 2

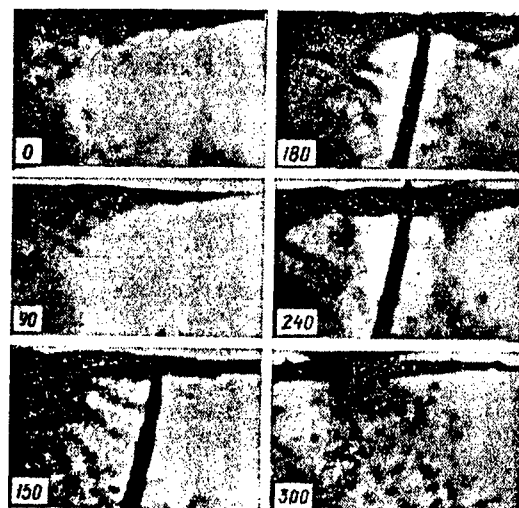


Figure 3

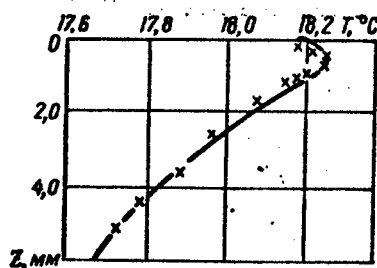


Figure 4

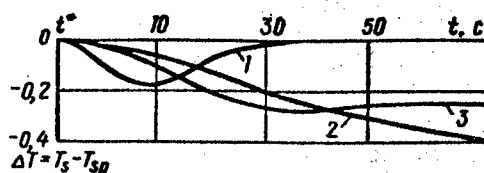


Figure 5

Let us examine some results of experimental investigations of microconvections and the thermal state of the water layer near the surface, conducted at the Hydromechanics Institute of the Ukrainian SSR Academy of Sciences. Microconvection was observed by means of a schlieren instrument; the thermal structure was investigated with an infrared radiometer with a working range of 3-5 micrometers, which corresponded to an effective depth of  $z_{\text{eff}} = 0.6$  mm, and a thermocouple with a scale of 50 micrometers. The schlieren picture of the development of microconvections in the water layer near the surface in the course of 30 seconds is depicted in Figure 3.

The upper edge of the photograph corresponds to the air-water interface, and the dark places in the photographs to regions with a nonzero density gradient, which in the given experiments can be caused only a temperature gradient. The observation time has been indicated on the photographs.

The presented results show that in the water layer near the surface, 0.5 cm thick microconvection arises. As a result of cooling of the surface, significant water layers sink inside the liquid, forming cold thermal streams. A characteristic temperature profile, measured with a thermocouple, is shown in Figure 4. The air temperature far from the water surface was  $18.3^{\circ}\text{C}$ , the water temperature at a depth of  $z = 15\text{ cm}$  was constant at  $16.95^{\circ}\text{C}$ . In the investigation a temperature rise was clearly fixed--the temperature of the water layer near the surface in proportion to increase of the depth at first rises from  $T_s = 13.17^{\circ}\text{C}$  to a maximum of  $T_{\text{max}} = 18.25^{\circ}\text{C}$  at a depth of the order of 0.5 cm, and then monotonically drops to its constant value  $T_{\infty} = 16.95^{\circ}\text{C}$ . It is noted that on schlieren photographs the hydrodynamic changes were also fixed in the upper water layer 0.5 cm thick, that is, in the temperature inversion layer. In the infrared photographs, the strong influence of the introduced thermocouple on the process of microconvection development is clearly visible.

In September 1982 on the Black Sea the following investigation was conducted: in a time of dead calm and clear weather the temperature at a depth of  $z_{\text{eff}}$  reckoned from the surface was measured with an infrared radiometer. Then a float was towed across the water surface which destroyed the inversion layer. With an infrared radiometer an investigation was made of the dynamics of the destruction and restoration of the inversion layer. The dependences of the temperature differences of unperturbed  $T_s$  and perturbed  $T_{\text{sp}}$  surfaces for some investigations are given in Figure 5. The time  $t$  corresponds to the time of passage of the small float under the radiometer. In all cases elevations of the surface temperature were recorded after passage of the float. And so the sea surface had a lower temperature than that at some depth. During passage of the small float the upper layer was destroyed and warmer water was carried from the lower layers to the surfaces. In the first investigation the drop was  $\Delta T_1 = 0.17^{\circ}\text{C}$ .

Twenty-five seconds after passage of the float the surface temperature attained the previous value. In the second and third investigations, far larger drops of  $\Delta T_2 = -0.5^{\circ}\text{C}$  and  $\Delta T_3 = -0.33^{\circ}\text{C}$  were registered. In the second investigation, the temperature drop was established 90 seconds after passage of the float, and in the third after 25 seconds. Restoration of the initial surface temperature was not determined because of limitation of the observation time. The large difference in the temperature drops and the surface temperature restoration time is explained by different investigation conditions--the former were conducted in the morning, when solar radiation intensity was not great, and the second and third in the second half of the day, when it was close to the maximum, which also led, according to the quoted theoretical results, to the formation of a large temperature drop and increase of the time for restoration of the surface temperature.

Figure 6 presents a schlieren photograph of forced convection in the water layer near the surface. The experiment was conducted as follows: at the moment of time  $t = 0$  to which the first photograph corresponds, a fan installed above the water surface was switched on. At the same time a photograph was made of the schlieren pictures of the water layer near the surface

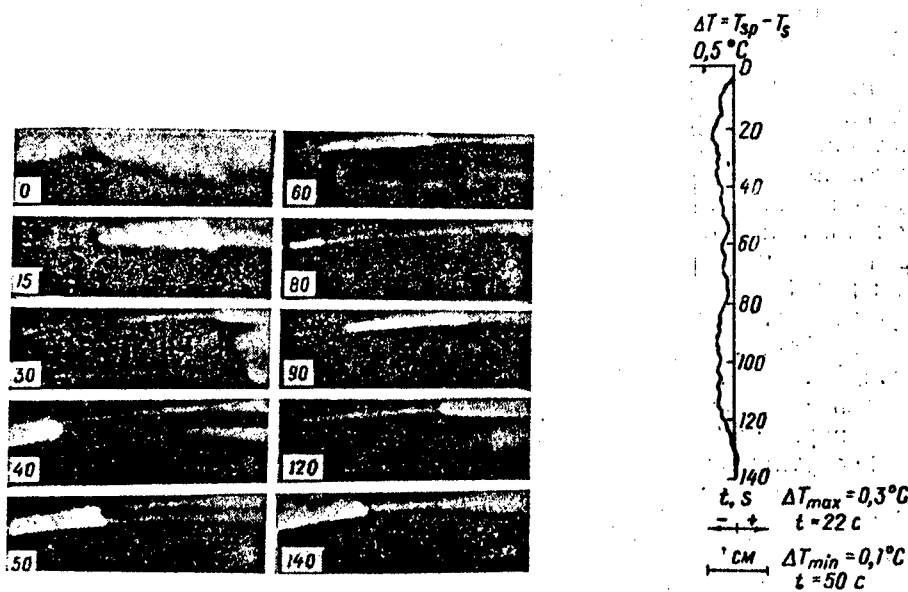


Figure 6

and the temperature surface, recorded with an infrared radiometer. The upper edge of the photograph corresponds to the air-water interface and the figures indicate the observation time in seconds; beside the photographs is given the characteristic scale of length and the radiometer recording is presented. On the photographs the light spots correspond to regions with a nonzero density gradient. As follows from the record of the infrared radiometer, after the fan is switched on the water surface temperature drops ( $T_s$  on the recording designates the surface temperature before the start of ventilation,  $T_{sp}$ —after). The maximum value of  $\Delta T_{max} = T_{sp} - T_s = -0.3^\circ \text{C}$  was recorded 22 seconds after the fan was switched on. Then the temperature began to rise and after about 55 seconds the difference  $T_{sp} - T_s$  became minimal and equal to  $-0.1^\circ \text{C}$ . Then the surface temperature again began to decline. When the experiment had proceeded 110 seconds the fan was switched on and in the course of the next 25 seconds the surface temperature reached its initial value. On the schlieren photographs the development of convection is well traced in the ventilated layer of water near the surface; besides, the character of the development of forced convection differs qualitatively from that shown in Figure 3.

Forced convection, as follows from schlieren photographs, develops on a background of a quasistationary state which was formed in the given experiment 15 sec after the start of ventilation (the second schlieren photograph). The state is characterized by the presence of a temperature jump at a depth of the order of 0.5 cm, during the time of which the cold heating conditions were interrupted. The process of formation and interruption of cold heating



conditions is illustrated on schlieren photographs by the formation of a second light streak which drops deep in the liquid with a velocity of the order of 1 mm/sec. The investigations show that in the water layers within about 0.5 cm of the surface there forms a complex hydrothermodynamic picture which must be taken into consideration in the construction of a model of the interaction of a reservoir with the atmosphere.

#### BIBLIOGRAPHY

1. Nelepo, B. A., "Problemy, raznozhnosti i perspektivy kosmicheskoy okeanographii" [Problems, Possibilities and Prospects of Cosmic Oceanography] Sebastopol, Marine Hydrophysical Institute (Preprint No 4), 1979.
2. Nelepo, V. A. Kuftakov, Yu. M., and Kosnyrev, V. K., "The Task of Determining the Parameters of Synoptic Vortexes in the Ocean from an Artificial Earth Satellite", DOKLADY AN SSSR, Vol 242, No 6, 1978, pp 1289-1292.
3. Khundzhua, G. G., Gusev, A. M., Gurov, V. V., and Skorokhvatov, N. A., IZVESTIYA AN SSSR, FIZ.-ASTRONOM. OTDELENIYE, Vol 13, No 7, 1977, pp 753-758.
4. Katsaros, K. B., "The Aqueous Thermal Boundary Layer", BOUNDARY LAYER METEOROLOGY, Vol 18, No 1, 1980, pp 107-127.
5. Kuftakov, Yu. M., Nelepo, B. A., and Fedorovskiy, A. D., "The Temperature Skin Layer of the Ocean," DOKLADY AN SSSR, Vol 238, No 2, 1978, pp 296-299.
6. Kuftakov, Yu. M., Nelepo, B. A., and Fedorovskiy, A. D., "The Cold Temperature Skin Layer of the Ocean," IZVESTIYA AN SSSR, FIZ.-ASTRONOM. OTDELENIYE, Vol 14, No 1, 1978, pp 88-93.
7. Fedorovskiy, A. D., "Opticheskiye metody v gidromekhanike" [Optical Methods in Hydromechanics], Kiev, Naukova dumka, 1984.

2174

CSO: 1862/170

UDC 536.24:532.542.4:535.338

EXPERIMENTAL INVESTIGATION OF HEAT RELEASE DURING TURBULENT FLOW IN ROUND  
TUBE OF NON-EQUILIBRIUM DISSOCIATING COOLANT

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 5, Sep-Oct 84  
(manuscript received 1 Dec 83) pp 913-918

MOLODYKH, E. I., NOVIKOV, V. P. and PUSTOGAROV, A. V.

[Abstract] This study investigates the influence on heat exchange of the process of the establishment of equilibrium during the dissociation of heated methyl alcohol. The local coefficients of heat release were determined in an open-loop system employing dc resistance heating. The local coefficient of heat release were determined by finding indirectly the distribution of the specific heat flux along the channel, the inner wall temperature, and the average cross-sectional temperature of the gas mixture. The experimental and calculated release of heat to methanol and methanol-argon mixtures are plotted. Figures 4; references 9: 5 Russian, 4 Western. [164-6900]

UDC 662.997

MODEL CALCULATION OF THE TEMPERATURE FIELD OF AN IDEAL PARABOLIC  
REFLECTOR

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-  
TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 6,  
Nov-Dec 84, pp 17-21

NAZAROV, A., NAZAROV, Sh., REDZHEPOVA, O., MACHUYEV, Yu. I. and FOKIN, V. G.

[Abstract] A simplified differential equation for the temperature of a solar-heated ideal parabolic reflector was derived and numerically solved with boundary conditions corresponding to thermal insulation and free heat-exchange at the edge. The equilibrium temperatures established at a given point in the absence of heat flow along the reflecting surface were calculated. A quantitative estimate of the effect of heat flow from the

center to the edge was obtained for different diameters of the reflector by comparing the computer calculations with the equilibrium temperatures. It was shown that heat flow from the center to the edge can be ignored in ideal reflectors whose diameter exceeds 1 m. An overall criterion, which incorporates both the effects of all destabilizing factors independent of their origin, e. g. radiation, wind, radiant heat exchange with the environment, and the thermophysical properties of the structural elements, was developed in order to distinguish stationary and nonstationary processes. The criterion also characterizes the amplitude and rate of change of the heat-exchange conditions. Figures 2; references: 2 Russian.  
[315-9638]

UDC 536.21

#### HEATING OF METAL SURFACE BY LASER RADIATION CONSIDERING TEMPERATURE DEPENDENCE OF REFLECTIVITY

Minsk VESTSI AKADEMII NAVUK BSSR SERYYA FIZIKA-MATEMATYCHNYKH NAVUK  
in Russian No 1, Jan-Feb 85 (manuscript received 28 Mar 83) pp 100-105

KAPEL'YAN, S. N. and MORGUN, Yu. F., Belorussian Polytechnical Institute,  
Electronics Institute, Belorussian SSR Academy of Sciences.

[Abstract] The reflectivity of a metal surface is examined experimentally as a function of temperature. A system of equations is derived to describe the heating of a metal surface disregarding phase transitions. The theoretical results are compared with experimental findings. Figures 1; references: 4 Russian.  
[299-6900]

H-CONVEX SET METHOD IN DIFFERENTIAL GAMES

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR: SERIYA A FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 12, Dec 84  
(manuscript received 15 Dec 83) pp 62-64

OSTAPENKO, V. V., Cybernetics Institute, Ukrainian SSR Academy of Sciences.

[Abstract] Relatively simple strategies are proposed for new, rather broad, classes of linear differential games. The concept of an H-convex set is extended to the case of Banach space. A finite dimensional game with fixed ending time is examined. Three examples are presented. References:

7 Russian.

[219-6900]

UDC 519.614

DETERMINATION OF EXTREMAL EIGENVALUES BY MINIMIZATION OF FUNCTIONALS OF SPECIAL TYPE

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian  
Vol 25, No 2, Feb 85 (manuscript received 22 Feb 84 after revision)  
pp 292-295

SAVINOV, G. V., Leningrad.

[Abstract] A method is presented for finding the extremal eigenvalues of symmetrical positively-defined matrices by minimizing functionals of the type  $v(x) = (Ax, x) + \phi((x, x))$ , where  $\phi(s)$  is some function. The proposed functionals are investigated theoretically, and the results of test calculations are presented. It is found that the rate of convergence of the minimization of the functional  $v(x)$  can be speeded up by selecting the parameters appropriately. Reference: 1 Russian.  
[318-6900]

UDC 519.615.7

COINCIDENCE OF ERRORS IN CLASSES OF PASSIVE AND SEQUENTIAL ALGORITHMS

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI  
in Russian Vol 25, No 2, Feb 85 (manuscript received 3 Apr 84) pp 295-298

SYKHAREV, A. G., Moscow.

[Abstract] The coincidence of the error minimax in the classes of passive and sequential algorithms is investigated. Sufficient conditions are derived for that coincidence for the general problem of approximating some operator. The problem of integrating in classes of monotonic functions and functions satisfying the Lipschitz condition is cited as an example of the case in which the coincidence of the error minimax in the classes of passive and sequential algorithms can be proved even though no universal worst-case function  $f_0$  exists. References 7: 5 Russian, 2 Western.  
[318-6900]

## DIFFUSION CHAOS IN NONLINEAR DISSIPATIVE SYSTEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 5, Dec 84  
(manuscript received 27 Apr 84) pp 1091-1096

AKHROMEYEVA, T. S., KURDYUMOV, S. P., MALINETSKIY, G. G. and  
Academician SAMARSKIY, A. A., Applied Mathematics Institute  
imeni N. V. Keldysh, USSR Academy of Sciences.

[Abstract] The onset of chaos is investigated for an equation describing the behavior of a broad class of two-component systems in the vicinity of the bifurcation point, which is also employed in wave theory, plasma physics and in morphogenetic modeling. A computational experiment in conjunction with analysis of some simplified models is described. It is found that non-periodic modes can determine the asymptote of a problem in partial derivatives. Figures 3; references 14: 9 Russian, 5 Western.  
[290-6900]

UDC 517

## ERROR OF MONTE CARLO METHOD IN SOLVING VECTOR TRANSFER EQUATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 5, Dec 84  
(manuscript received 29 Feb 84) pp 1046-1049

MIKHAYLOV, G. A., Computer Center, Siberian Department, USSR Academy of Sciences.

[Abstract] A system of integral radiation transport equations with polarization is investigated. A vector random quantity  $\xi_x$  such that  $||M||\xi_x = \Phi(x)$  is constructed in order to estimate the solution of that system of equations by the Monte Carlo method. Equations are derived that allow the problem of minimizing a continuous matrix-integral operator to be solved numerically. References: 5 Russian.  
[290-6900]

DEVELOPMENT OF METHODS FOR CERTIFYING ALGORITHMS FOR PROCESSING  
OBSERVATION RESULTS

Moscow METROLOGIYA in Russian No 2, Feb 85 pp 3-8

TARBEEV, Yu. V., CHELPANOV, I. B. and SIRAYA, T. N.

[Abstract] This study describes a system for certifying algorithms for processing observation results in order to allow investigators to compare algorithms objectively and to make substantiated choices for specific tasks. The certification system is based on a classification in terms of structural features: the type of computational procedure, the type of characteristics sought, and the form in which the initial data and end results are represented. Algorithm performance indicators and standard models of initial data are established for each group of algorithms, with the performance indicators being divided into accuracy, stability and complexity indicators. The implementation of the certification system will make it possible to reduce the labor involved in metrological work and to enhance the accuracy and reliability of measurement results.

[289-6900]

UDC 519.21

VALIDATION OF UNILATERAL  $3\sigma$  RULE FOR UNIMODAL DISTRIBUTIONS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 1, Jan 85 (manuscript received 14 Jun 83) pp 6-8

VYSOCHANSKIY, D. F. and PETUNIN, Yu. I., Kiev State University

[Abstract] The problem of deriving unilateral confidence intervals for unimodal distributions is examined. The inequality  $P(\xi \geq M\xi + 3\sigma) \leq 2 \cdot 45^{-1} < 0.045$  is proved for all nondegenerate unimodally distributed random quantities  $\xi$  with finite second moments  $M\xi^2$ , where  $M\xi$  is the mathematical expectation of  $\xi$ , and  $\sigma$  is the standard deviation of  $\xi$ . A theorem is stated and proved that validates the unilateral  $3\sigma$  rule based on the above equality, which is of interest for modern mathematical statistics in connection with constructing confidence integrals for unknown parameters. References: 6 Russian. [283-6900]

UDC 517.39:519.4

ENTROPY MAXIMALITY CRITERION FOR BOUNDARY OF RANDOM WALKS ON DISCRETE GROUPS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85 (manuscript received 20 Mar 84) pp 1051-1054

KAYMANOVICH, V. A., Leningrad State University imeni A. A. Zhdanov

[Abstract] The differential entropy of the boundary is associated with the entropy of the initial random walk and conditional walks that occur when the boundary point is fixed. The maximality of the boundary is proved by verifying that the entropy of the conditional random walks is zero, which follows from the geometric properties of groups in specific cases. Examples are presented that extend all known cases of complete description of a nontrivial random walk boundary on a countable group. The use of entropy theory imposes constraints on the measures examined,



so that the maximality of the "natural boundary" for an arbitrary measure, e.g., on a free group, remains open. References 15: 5 Russian, 10 Western. [265-6900]

UDC 519.21

#### LIMITING THEOREMS FOR FUNCTIONALS OF IRREVERSIBLE RANDOM WALKS

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 14 Dec 83) pp 64-74

MIRZOYEVA, T. M. and PORTENKO, N. I., Mathematics Institute, Ukrainian SSR Academy of Sciences

[Abstract] A number of limiting-case theorems are proved for functions of irreversible random walks that become reversible at the limit. The conditions for nondegeneracy of the limiting distributions are investigated. Three theorems are stated and proved. References 7: 6 Russian, 1 Western. [260-6900]

UDC 519.21

#### STABILITY WITH PROBABILITY OF UNITY FOR SYSTEMS OF LINEAR STOCHASTIC DIFFERENTIAL EQUATIONS

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 23 Nov 83) pp 103-107

RUDOMINO-DUSYATSKAYA, I. A., Kiev State University

[Abstract] This study investigates the conditions of stability, with probability of unity, of solutions of matrix equations of the type

$$dX_t = AX_t dt + BX_t dw(t) \quad (1)$$

where  $X_t$  is a matrix random function,  $A=[a_{ij}]$ ,  $B=[b_{ij}]$ ,  $a_{ij}, b_{ij} \in R^1$ ,  $i, j = \overline{1, n}$ ,  $w(t)$  is a unidimensional Wiener process, assuming that the system is irreducible, i.e.,  $A$  and  $B$  have no common nontrivial characteristic subspaces. An example of a second-order system is presented. References 6: 5 Russian, 1 Western. [260-6900]

## SOLVABILITY OF STOCHASTIC DIFFERENTIAL EQUATIONS WITH DEVIATING ARGUMENT

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 12 Jul 84 after revision) pp 98-103

RODKINA, A. Ye., Voronezh Construction Engineering Institute

[Abstract] The Cauchy problem is examined for the stochastic differential equations with deviating argument

$$dx(t) = a(t, x(h(t)))dt + b(t, x(h(t)))dw(t), \quad 0 \leq t \leq T; \quad x(0) = 0 \quad (1)$$

$$d[x(t) - f(t, x(\tau(t)))] = a(t, x(h(t)))dt + b(t, x(h(t)))dw(t), \quad 0 \leq t \leq T; \quad x(0) = 0. \quad (2)$$

The Lipschitz condition with respect to the second argument of the functions  $a(t, u)$  and  $b(t, u)$  is replaced with a less restrictive condition, and the operator  $(Fx)(t) = x(t) - f(t, x(\tau(t)))$  is assumed to be reversible. The theory of the measures of non-compactness and compacting operators is employed to prove the existence and uniqueness theorem of the problems. References 9: 7 Russian, 2 Western.  
[260-6900]

## STRUCTURE OF RIGOROUSLY MARKOVIAN MARKED RANDOM CLOSED SETS

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 23 Jun 83) ppp74-80

MOLCHANOV, I. S., Kiev State University

[Abstract] The concept of marked rigorously Markovian random closed sets, which represent a special class of the marked random closed sets examined in a previous study by the author, is introduced. The object that corresponds to a marked rigorously Markovian random closed set in the theory of standard regenerative phenomena are connected systems of regenerative phenomena. The random closed sets are shown to form a class that coincides with the class of sets that are the images of processes with independent increments in a random medium with increasing trajectories of the continuous component. The set of the level of a rigorously Markovian process with discrete component is shown to represent a rigorously Markovian marked random closed set. A method is presented for calculating accompanying functional of a rigorously Markovian marked random closed set on a certain class of compacts. References 14: 7 Russian, 7 Western.  
[260-6900]

## INVESTIGATION OF METHODICAL ERROR COMPONENT OF STATISTICAL ANALYSIS OF EXTREMA

Novosibirsk AVTOMETRIYA in Russian No 6, Nov-Dec 84  
(manuscript received 11 Mar 80) pp 23-28

ZHULEV, V. I., PETUKHOV, V. I. and SADOVSKIY, G. A., Ryazah'.

[Abstract] A steady-state ergodic twice-differentiable random process with null mean and finite variance in the region of two differential corridors is examined. A general expression is derived that relates the relative error in determining the distribution density of the maxima in one of the corridors with the characteristics of the process and parameters of the analyzer. Two models of a random process are investigated as an example. It is found that the component of the methodical error of the statistical analysis of extrema resulting from the discrete measurement method can be comparable to, or significantly greater than, the error related to the finite sample size. The analytical expressions derived can be used to solve the direct problem of estimating the error in determining the distribution density of the extrema, as well as the inverse problem of finding the digitization frequency needed to ensure the required acceptable analytical error. Figures 3; references: 5 Russian.  
[269-6900]

UDC 519.21

## ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF HEAT CONDUCTIVITY EQUATION WITH WHITE NOISE ON RIGHT-HAND SIDE

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 29 Nov 83) pp 13-20

DOROGVTSEV, A. Ya., IVASISHEN, S. D. and KUKUSH, A. G., Kiev State University

[Abstract] A heat conductivity equation with random sources assigned in a constrained region of change of the spatial variable and on an unbounded time interval is investigated, representing one of the first studies of the asymptotic behavior of the solutions of such equations. The conditions are found under which the solutions have a probability of unity of approaching zero as  $t$  approaches infinity. Five theorems are stated and proved. References 6: 5 Russian, 1 Western.  
[260-6900]

## THE ELLIPTICAL LAW

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI in Russian No 1, Jan 85 pp 56-59

GIRKO, V. L., Kiev State University.

[Abstract] A schema is presented for proving the fundamental theorem of the spectral theory of non self-conjugate random matrices. The findings leading up to that theorem are traced from E. Wigner's initial 1958 study. The proof of the 'semicircular' law for symmetrical random matrices and the 'circular' law for asymmetrical random matrices with independent elements is described. A theorem, referred to as the elliptical law, is formulated and proved for the limiting spectral function for the case in which the vectors  $(\xi_{p1}, \xi_{1p})$ ,  $p > 1$ , are independent, and the elements  $\xi_{p1}$  and  $\xi_{1p}$  of the random matrices  $H_n$  are independent of one another. The distribution density of the spectral function can be found by V-transformation for these matrices, and is equal to some constant on a region described the equation for an ellipse. References 11: 7 Russian, 4 Western.  
[283-6900]

UDC 519.856.3

## LIMIT THEOREM FOR VARIABLE-STEP OPTIMIZATION AND ESTIMATION ALGORITHMS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNIЧЕСKIYE NAUKI in Russian No 1, Jan 85  
(manuscript received 20 Dec 83) pp 59-61

KANIOVSKIY, Yu. M., Cybernetics Institute, Ukrainian SSR Academy of Sciences.

[Abstract] A limit theorem is presented for stochastic approximation-type Markov algorithms in which the step size is an arbitrary function of the iteration number. The iterative procedure in question is called an algorithm with a rapidly-decreasing step for  $\tau > 0$ ; it is called an algorithm with a slowly decreasing step if  $\tau = 0$ . References: 6 Russian.  
[283-6900]

UDC 517.977.52

OPTIMUM CONJUGATION OF NON-SINGULAR CONTROL SECTIONS IN A TERMINAL CONTROL PROBLEM

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 116,  
No 1, Oct 84 (manuscript received 1 Apr 83) pp 25-28

MANSIMOV, K. B., Cybernetics Institute, Azerbaijan SSR Academy of Sciences.

[Abstract] A terminal control problem with a free right end of the trajectory is investigated. A new approach is proposed for obtaining the necessary conditions for optimal conjugation in the case of any arbitrary fixed natural number of special points of control  $u(t)$ . The relationship between the conditions derived and the corresponding findings from previous studies is established. References: 7 Russian.  
[319-6900]

UDC 62-50

OPTIMALITY CONDITIONS IN OPTIMIZATION PROBLEMS WITH AN INTEGRAL QUALITY CONDITION

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 6,  
Nov-Dec 84 (manuscript received 14 Apr 82) pp 3-6

ABRAMENKO, S. N., SEYSOV, Yu. B. and POLATOV, M. B., Physico-Technical Institute of the Academy of Sciences of the Turkmen SSR

[Abstract] The sufficient conditions were derived for the optimality of the extremal solution of control problems of the following form:

Find an admissible control  $u(t)$  for  $t_1 \leq t \leq t_f$  which transforms the system

$$\dot{x} = f(x, u), \quad x \in E_n, \quad u \in E_r \quad (1a)$$

from an initial state  $x_i$  into the final state  $x_f$  and at the same time minimizes a quality functional

$$J = \int_{t_i}^{t_f} f_0(x, u) dt. \quad (1b)$$

where  $f_0 > 0$ .

A theorem stating that the process  $\{x(x_0), u(x_0)\}$  is optimal and  $x_0^f$  is the minimum value of the functional (1b) was proved. References: 7 Russian. [315-9638]

UDC 518.61

# TOWARD NECESSARY CONDITIONS FOR OPTIMALITY IN PROBLEM WITH PHASE CONSTRAINTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85  
(manuscript received 24 Apr 84) pp 1033-1037

ARUTYUNOV, A. V.

[Abstract] This study presents minimum conditions for a minimization problem with constraints that do not satisfy Lyusternik's condition, as well as first- and second-order necessary conditions in an optimal control problem with phase constraints. The conditions are derived on the basis of extension of the penalty method. The problem  $f_0(x) \rightarrow \min, x \in X, F(x) = 0$  is investigated, where  $X, J$  are Banach spaces, the first of which is reflexive, and the mapping  $F: X \rightarrow J$  and the function  $f_0: X \rightarrow R^1$  are differentiable. Two theorems are stated and proved. References 9: 8 Russian, 1 Western. [265-6900]

UDC 517.977.55

# METHOD FOR APPROXIMATE SOLUTION OF ONE LINEAR OPTIMAL CONTROL PROBLEM DEPENDING UPON SMALL PARAMETER

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 29, No 2, Feb 85  
(manuscript received 26 Jan 84) pp 119-122

KALININ, A. I. and ROMANYUK, G. A., Belorussian State University  
imeni V. I. Lenin

[Abstract] A terminal control problem depending upon a small positive parameter is examined. A procedure is proposed that makes it possible for a given integer  $k \geq 0$  to construct a  $k$ -permissible control that is also  $k$ -optimal. The procedure consists essentially of making minor corrections

to the optimal control of the base problem, i.e., the problem obtained from the system of equations describing the terminal control problem.

References: 1 Russian.

[259-6900]

UDC 519.854.2

# BICRITERION PROBLEM IN THEORY OF SCHEDULING WITH VARIABLE MAINTENANCE TIME

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI in Russian  
Vol 24, No 10, Oct 84 (manuscript received 28 Mar 83, after revision 7 May 84)  
pp 1585-1590

TUZIKOV, A. V., Minsk

[Abstract] The problem of scheduling maintenance of a finite number of devices with variable rather than constant maintenance time is considered, where variation of the maintenance time results from involvement of additional resources and results in additional cost. Minimization of this cost is stipulated as second criterion, in addition to a given performance level as first criterion for maintenance scheduling. A set  $N$  of  $n$  requirements for a system of  $m$  devices is defined, each  $j$ -th device requiring a maintenance time  $t_{ij}$  to meet the  $i$ -th requirement in set  $N$ . A nondecreasing penalty function  $\phi_{ij}(t)$  and numbers  $c_{ij} \geq 0$  are assigned to each requirement. A set  $S(T)$  of  $S$  schedules on the basis of the set of maintenance times  $T$  is defined; the quality of each schedule  $s(T)$  is characterized by estimation functional  $F_1$  and the penalty for equal maintenance times is characterized by the functional  $F_2$ . The problem is then to find the Pareto set  $P_\epsilon$  of all efficient pairs  $(F_1, F_2)$  for a given  $\epsilon > 0$  and given target functionals  $F_1(s(T))$ ,  $F_2(T)$ . Inasmuch as  $F_2(T)$  is a linear functional, finding its minimum reduces to linear programming and involves an  $\epsilon$ -approximation of the  $P_\epsilon$  set. The algorithm is particularized for two determinate situations. In one case a sequence of requirements is logged at time  $d = 0$  for uninterrupted maintenance with one tool. In the second case requirements are logged for maintenance with parallel tools and with permissible interruptions.

References 6: 4 Russian, 2 Western.

[93-2415]

## CONSTRUCTION OF FUNCTIONAL RELATIONSHIPS OF MEASURED QUANTITIES WITH INCOMPLETE INITIAL DATA

Moscow METROLOGIYA in Russian No 2, Feb 85 pp 8-13

BALALAYEV, V. A., ROMANOV, V. N. and SLAYEV, V. A.

[Abstract] A method, based on fuzzy set theory, is proposed for selecting models in order to construct the functional relationships between measured physical quantities for the case in which those functional relationships are unknown a priori. The task is to select that alternative (model) that has the greatest possible estimates for all features, assuming that requirements imposed on the alternatives are usually contradictory, because of the ambiguity of the initial data, and no ideal solution exists. The case of three classes of models for describing a set of experimental data is analyzed as an example. The approach makes it possible to take simultaneous account of objective and subjective features, and to describe situations characterized by incomplete initial data regarding the compared alternatives. The initial data can be analyzed comparatively, and 'uninformative' data can be identified. These features make the approach helpful in complex multifactorial problems associated with estimating measurement performance, making decisions on the basis of measurement results and optimizing metrological systems. References 3: 2 Russian, 1 Western.  
[289-6900]

UDC 517.977.52

## NECESSARY EXTREMUM CONDITIONS IN MINIMAX PROBLEM OF OPTIMAL CONTROL OF NON-SMOOTH SYSTEMS WITH CONSTRAINTS

Minsk VESTSI AKADEMII NAVUK BSSR SERIYA FIZIKA-MATEMATYCHNYKH NAVUK in Russian No 1, Jan-Feb 85 (manuscript received 7 Dec 82) pp 18-25

GAYSHUN, P. V. and MORDUKHOVICH, B. Sh., Mathematics Institute, Belorussian SSR Academy of Sciences.

[Abstract] This study investigates the problem of terminal control with variable process duration and minimax constraints on the trajectory of the non-smooth differential system. The necessary conditions for optimality are derived by approximating the initial non-smooth problem with constraints on the state variables by a sequence of optimal control problems with a smooth right part and free trajectory end. The optimality conditions are formulated in the form of Pontryagin's maximum principle, as well as in maximin form. References 12; 11 Russian, 1 Western.  
[299-6900]



## EXISTENCE THEOREM FOR ONE CLASS OF OPTIMAL PROBLEMS WITH SWITCHING AND VARIABLE DELAYS

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 116,  
No 1, Oct 84 (manuscript received 5 May 83) pp 33-35

AVALISHVILI, N. M., Control Systems Institute, Georgian SSR Academy of Sciences.

[Abstract] The optimal problem is stated for one class of controlled system with switching that contains variable delays in the phase coordinates as well as the control. An existence theorem is derived.

References: 2 Russian.

[319-6900]

UDC 519.853.62

TOWARD THE DIRECTIONAL DIFFERENTIATION OF A DISTANCE FUNCTION

Minsk VESTSI AKADEMII NAVUK BSSR SERYYA FIZIKA-MATEMATYCHNYKH NAVUK  
in Russian No 1, Jan-Feb 85 (manuscript received 11 Mar 85) pp 121-122

BORISENKO, O. F., ZHEVNYAK, R. M. and MINCHENKO, L. I., Minsk Radio Engineering  
Institute.

[Abstract] The distance function  $d(z) = \rho(y, F(x))$ ,  $z = (x, y)$  is examined, where  $F(x)$  is the image of the multi-valued compact valued mapping  $F : X \rightarrow 2^{\mathbb{R}^m}$ ;  $X$  is an open set in  $\mathbb{R}^n$ . A necessary and sufficient condition for the differentiability of the function  $d(z)$  is presented. The complete text is on file at the All-Union Scientific and Technical Information Institute.

[299-6900]

UDC 517.956

INHOMOGENEOUS BOUNDARY-VALUE PROBLEM FOR SECOND-ORDER DIFFERENTIAL-  
OPERATOR EQUATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85  
(manuscript received 22 Mar 84) pp 1055-1058

KISLOV, N. V., Moscow Power Engineering Institute

[Abstract] A boundary value problem for an equation of the type  $Au''(t) + Bu(t) = f(t)$ ,  $t \in (0, T)$  is examined, where  $A$  and  $B$  are symmetrical operators in Hilbert space;  $B$  is a positive operator, and the spectrum of operator  $A$  is positioned arbitrarily. Two theorems are stated and proved. An example of the boundary-value problem for an equation in partial derivatives is presented. References: 3 Russian.

[265-6900]

STRAIGHT-LINE METHOD FOR QUASILINEAR PARABOLIC-TYPE EQUATION WITH  
NONCLASSICAL BOUNDARY CONDITION

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 23 Dec 83) pp 42-48

MAKAROV, V. L. and KULYYEV, D. T., Kiev State University

[Abstract] This study employs precision difference scheme operators to construct a straight-line method for a quasilinear heat conductivity equation with nonclassical boundary condition. The existence and uniqueness of the generalized solution of the scheme in the space to which the solution of the boundary problem belongs are proved; the rate of convergence of the scheme is investigated. References: 8 Russian.

[260-6900]

UDC 517.9

METHOD OF AVERAGING IN PULSED SYSTEMS

Kiev UKRAINSKIY MATEMATICHESKIY ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 28 May 84) pp 56-64.

MITROPOL'SKIY, Yu. A., SAMOYLENKO, A. M. and PERESTYUK, N. A.,  
Mathematics Institute, Ukrainian SSR Academy of Sciences

[Abstract] This study reviews findings associated with the extension of the method of averaging to systems of differential equations subjected to pulse perturbation. Systems with one degree of freedom and systems in standard form are investigated. A method for applying asymptotic methods of nonlinear mechanics to the study of oscillatory processes in systems with distributed parameters is described. References 22: 20 Russian, 2 Western.

[260-6900]

## THE LYAPONOV MATRIX-FUNCTION AND THE STABILITY OF MOTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85  
(manuscript received 3 Mar 84) pp 1062-1066

MARTYNYUK, A. A., Mechanics Institute, Ukrainian SSR Academy of Sciences

[Abstract] A system of differential equations  $\frac{dx}{dt} = f(x)$ , where  $x \in \mathbb{R}^n$ ,

$0 \leq t < \infty$ ,  $f: N \rightarrow \mathbb{R}^n$  is continuous and satisfies the Lipshitz condition with respect to  $x$  in  $N$ , is examined. The solution  $\chi(t; x_0)$  is unique and is a continuous function  $t_0, f_0; t_0 \geq 0, x_0 \in \text{int } N$ , where  $N$  is an open connected

set in  $n$ -dimensional Euclidean space with natural norm. The problem of stability in product space for a system of differential equations for perturbed motion is investigated as an example. References 6: 4 Russian, 2 Western.

[265-6900]

UDC 519.622.2

## ACCURACY OF MONOTONIC SCHEMES FOR SOLUTION OF STIFF SYSTEMS OF DIFFERENTIAL EQUATIONS

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI  
in Russian Vol 24, No 10, Oct 84 (manuscript received 14 Mar 83,  
after revision 21 Mar 84) pp 1577-1581

SHIRKOV, P. D., Dubna

[Abstract] Stiff systems of differential equations  $\frac{du}{dt} = -f(t, u)$  ( $t > 0, u(0) = a$ ,  $u = \{u_1, \dots, u_m\}$ ,  $f = \{f_1, \dots, f_m\}$ ,  $a = \{a_1, \dots, a_m\}$ ) and numerical methods of their

solution are considered, of particular interest being  $L$ -monotonic  $L$ -conservative difference schemes with optimum  $L$ -damping. A priori estimates of their accuracy are sought which within a given grid norm do not depend on the properties of specific problems. The  $\lambda$ -uniform convergence of a difference-scheme solution to the differential-system solution is defined relative to Cauchy problems for systems of differential equations with linear right-hand side  $f(t, u) = Au$ ,  $\lambda$  being the largest eigenvalue of the  $A$ -matrix. Asymptotic accuracy estimates are obtained in the  $c$ -space norm on the basis of a  $\tau \rightarrow 0$  convergence theorem. Upper-bound estimates are obtained in the  $l_p$ -space norm ( $p \geq 1$ ), with a constant coefficient independent of the eigenvalues, on the basis of a convergence in the mean at rate  $\tau^{1/p}$  theorem. The results are applied to various known difference schemes.

References 6: 5 Russian, 1 Western.

[93-2415]

## WAVE INTERACTION IN OPEN RESONATORS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 279, No 5, Dec 84  
(manuscript received 18 Jan 84) pp 1114-1117

KOSHPARENOK, V. N., MELEZHIK, P. N., POYEDINCHYK, A. Ye. and  
SHESTOPALOV, V. P., Academician, Ukrainian SSR Academy of Sciences,  
Radio Physics and Electronics Institute, Ukrainian SSR Academy of Sciences.

[Abstract] The occurrence of wave interaction is detected and studied within the framework of a mathematically rigorous spectral theory of a two-dimensional open resonator model with infinitely thin ideally conducting circular cylindrical mirrors. The spectral problem for the class of open resonators in question is equivalent to the problem of the characteristic numbers of the Fredholm operator function that depends analytically upon the spectral parameter  $K$ . It is found that regions of several close resonant frequencies are formed when the geometric and electrodynamic parameters of the open resonator change. There is an abrupt change in the intensity of the resonances in this region, as well as the  $Q$  of the oscillations and the spatial structure of the fields caused by the occurrence of irreversible (radiative) losses in the resonator, which causes electromagnetic coupling (interaction) between the oscillations in that region of frequencies. Figures 3; references: 9 Russian.  
[290-6900]

## INVERSION OF INTEGRAL OPERATORS WITH NEAR DIFFERENCE KERNEL

Yerevan DOKLADY AKADEMII NAUK ARMYANSKOY SSR in Russian Vol 79, No 1,  
Jan 84 pp 10-14

NERSESYAN, A. B. and CHERNYAVSKAYA, N. A., Institute of Mathematics,  
Armenian SSR Academy of Sciences, Khar'kov Cultural Educational School.

[Abstract] A previous study by one of the authors demonstrated that the classical method of investigation for normal resolution is applicable to an integral operator with dual near difference kernel along the entire axis. The present article extends the study of such operators. The findings regarding operators with composite difference kernels, as well as I. I. Komyak's finding for a conjugate equation, are generalized. L. A. Sakhnovich's basic findings regarding the construction of an operator inverse to a general operator with difference kernel are extended to the case of an operator with a near difference kernel. References 10: 9 Russian, 1 Western.  
[285-6900]

STABILIZATION OF TIME AVERAGES OF SOLUTION OF CAUCHY PROBLEM FOR SINGULAR  
HYPERBOLIC EQUATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 6, Feb 85  
(manuscript received 29 Nov 84) pp 1289-1293

DENISOV, V. N., Moscow State University imeni N. V. Lomonosov.

[Abstract] This study identifies the limiting exact necessary and sufficient conditions for the uniform (point) stabilization in  $E^N$  of the time averages of the solution of the Cauchy problem for second-order hyperbolic equations. The Cauchy problem is solved for the Euler-Poisson-Darboux equation for the case in which the real parameter  $K$  is nonnegative. References 14: 8 Russian, 6 Western.  
[278-6900]

## SOLUTION OF SYSTEMS OF BOOLEAN EQUATIONS IN TEST OR NELSON SYSTEMS

Moscow ZHURNAL VYCHISLITEL'NOY MATEMATIKI I MATEMATICHESKOY FIZIKI  
in Russian Vol 24, No 10, Oct 84 (manuscript received 13 Jun 83,  
after revision 21 May 84) pp 1590-1593

SAFARYAN, A. A., Moscow

[Abstract] Two kinds of Boolean systems of equations with left-hand sides constituting disjunctions are considered, namely test systems  $\bigvee_{j \in A_i} x_j = 1$

( $i=1,2,\dots,m$ ) with  $A_i \subseteq A(n) = \{1,2,\dots,n\}$  for all  $i = 1,2,\dots,m$  and Nelson

systems  $x_i^{\sigma_{1i}} \bigvee \dots \bigvee x_n^{\sigma_{in}} = 1$  ( $i = 1,2,\dots,m$ ) with  $\sigma_{ij} \in \{0,1\}$  for all

$i = 1,2,\dots,m$  and all  $j = 1,2,\dots,n$ . In both cases  $m \ll 2^n$  is fixed. A method of solving the Boolean system of equations is proposed which yields a short disjunctive normal form even for a large number of variables. The system is subdivided into groups of  $k$  equations ( $k = 2,3,\dots$ ) and first all equations within each group are multiplied, which results in a system of not more than  $m/k$  equations. A theorem is proved pertaining to the complexity of the shortest resulting disjunctive normal form, with a formula for calculating that complexity derived as a corollary. The algorithm of such a solution is demonstrated on the system of equations  $f_1(x_1, \dots, x_n) = 1$ . This problem can be reduced to the problem of maximum pair conjunctions, definable in terms of nonoriented graphs and solvable according to the Edmonds algorithm using the dichotomy of instantaneous threshold values. References: 2 Russian. [93-2415]

ESTIMATE OF POSITION OF MATRIX SPECTRUM WITH RESPECT TO PLANE CURVES

Kiev UKRAINSKIY MATEMATICHESKIYE ZHURNAL in Russian Vol 37, No 1, Jan-Feb 85  
(manuscript received 20 May 83) pp 38-42

MAZKO, A. G., Mathematics Institute, Ukrainian SSR Academy of Sciences

[Abstract] A method developed by the author for estimating the number of characteristic values of a matrix that belong to assigned regions is extended to a broader class of regions and of certain sets in the complex plane  $C^1$ . The classical solution to the problem is obtained with the help of Lyapunov's matrix equation. References 10: 9 Russian, 1 Western.  
[260-6900]

CSO: 1862

- END -